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**Kim et al.**

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(54) **COMPOUND AND ORGANIC LIGHT-EMITTING DIODE COMPRISING SAME**

(51) **Int. Cl.**  
*C07D 401/14* (2006.01)  
*C07D 403/04* (2006.01)

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(52) **U.S. Cl.**  
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(58) **Field of Classification Search**  
None  
See application file for complete search history.

(73) Assignee: **LG CHEM, LTD.**, Seoul (KR)

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 534 days.

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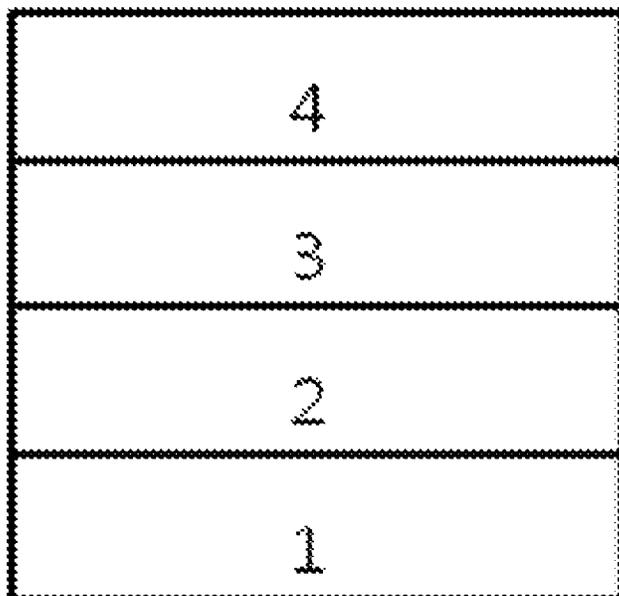
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Jul. 20, 2017 (KR) ..... 10-2017-0091898

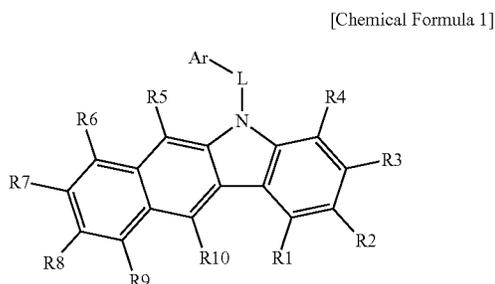
(57) **ABSTRACT**

The present specification provides a compound of Chemical Formula 1, and an organic light emitting device including

(Continued)



the same. The compound provides a low driving voltage, high light emission efficiency and a long lifetime of the organic light emitting device.



10 Claims, 8 Drawing Sheets

- (51) **Int. Cl.**  
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*C07D 495/04* (2006.01)  
*H01L 51/00* (2006.01)  
*H01L 51/50* (2006.01)
- (52) **U.S. Cl.**  
 CPC ..... *C07D 495/04* (2013.01); *H01L 51/0056* (2013.01); *H01L 51/0067* (2013.01); *H01L 51/0072* (2013.01); *H01L 51/0074* (2013.01); *H01L 51/5056* (2013.01); *H01L 51/5072* (2013.01); *H01L 51/5092* (2013.01)

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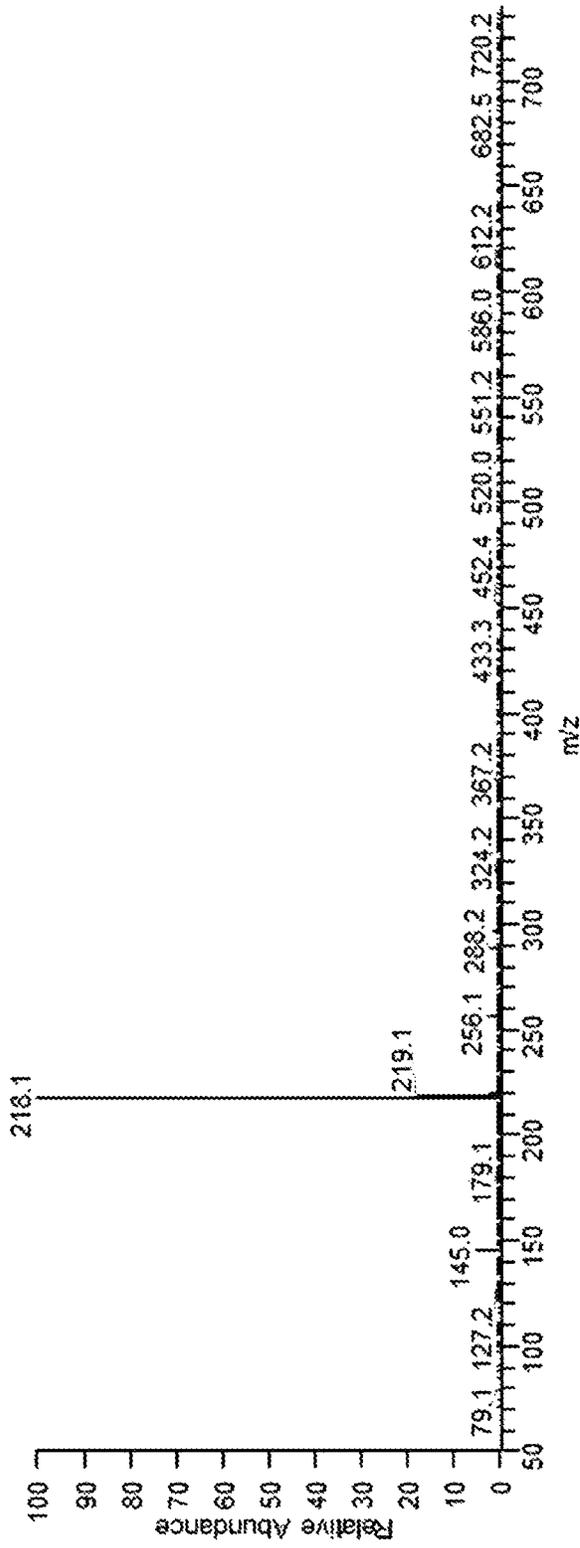
FIG. 1

4
3
2
1

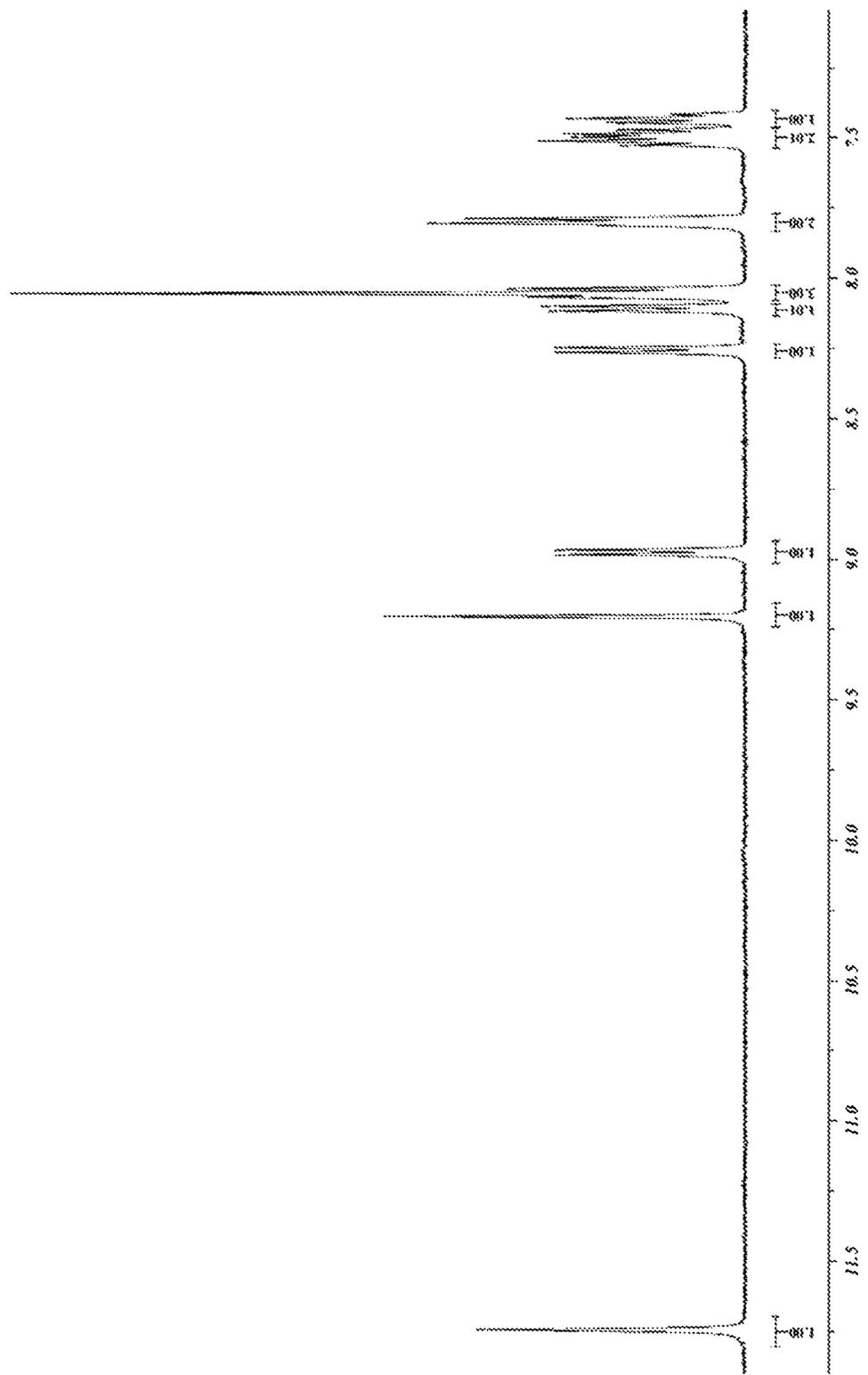
FIG. 2

4
7
3
6
5
2
1

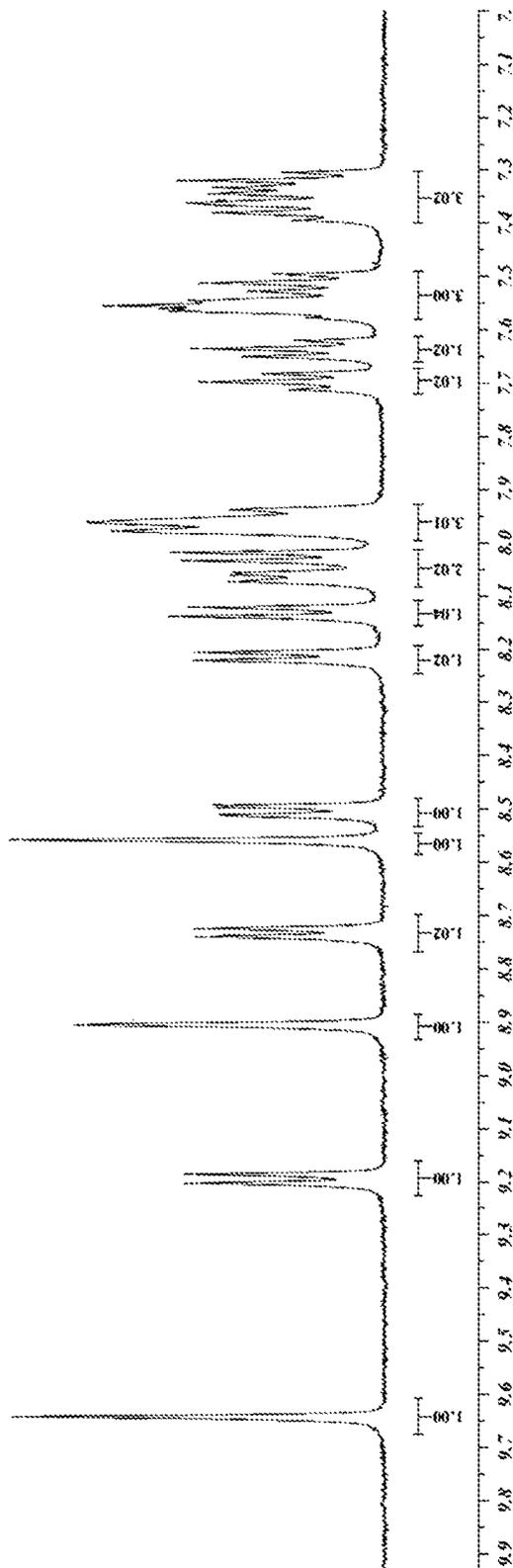




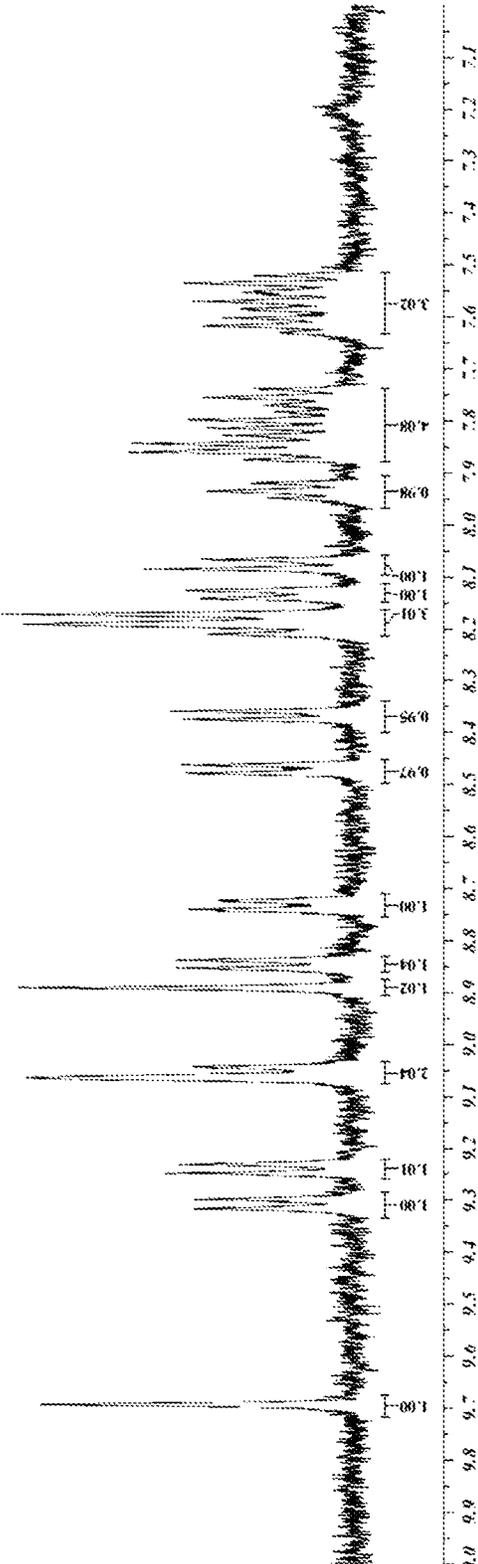
【FIG. 4】



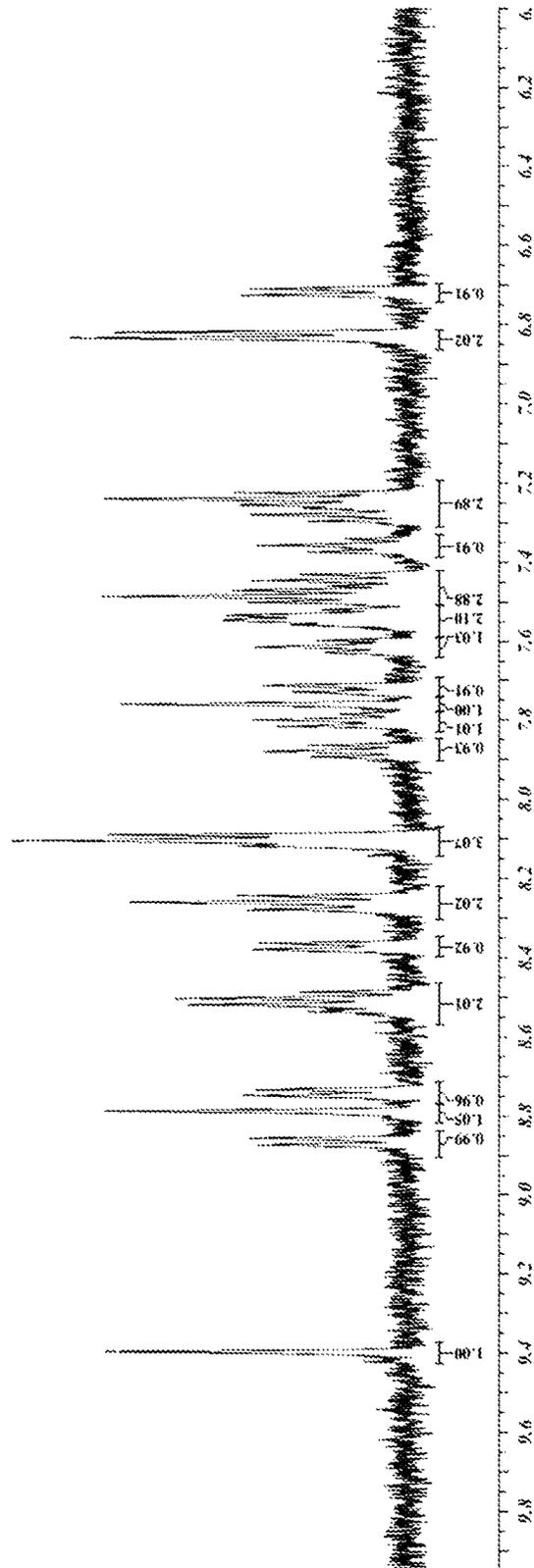
【FIG. 5】



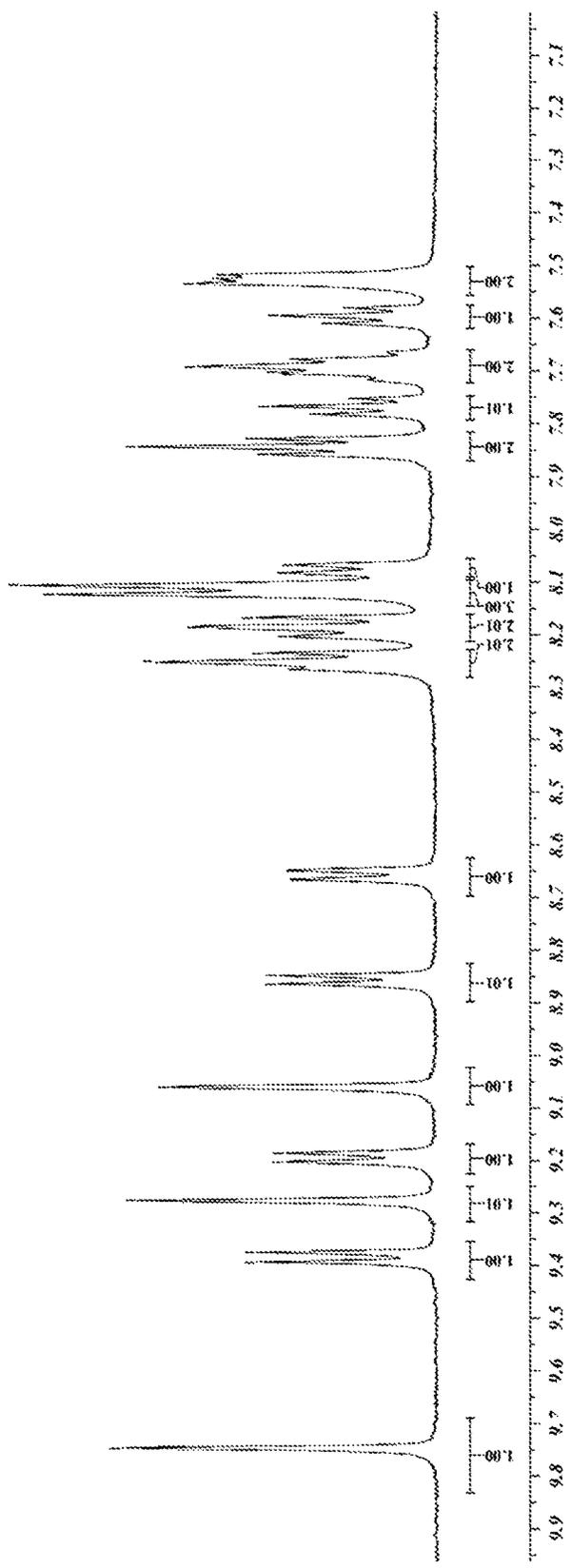
【FIG. 6】



【FIG. 7】



【FIG. 8】



【FIG. 9】

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**COMPOUND AND ORGANIC  
LIGHT-EMITTING DIODE COMPRISING  
SAME**

CROSS-REFERENCE APPLICATION

This is a National Stage Application of International Application No. PCT/KR2018/008247, filed Jul. 20, 2018 and claims priority to and the benefits of Korean Patent Application No. 10-2017-0091898, filed with the Korean Intellectual Property Office on Jul. 20, 2017, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

The present application relates to a compound and an organic light emitting device including the same.

BACKGROUND ART

An organic light emission phenomenon generally refers to a phenomenon converting electrical energy to light energy using an organic material. An organic light emitting device using an organic light emission phenomenon normally has a structure including a first electrode, a second electrode, and an organic material layer therebetween. Herein, the organic material layer is often formed in a multilayer structure formed with different materials in order to increase efficiency and stability of the organic light emitting device, and for example, may be formed with a hole injection layer, a hole transfer layer, a light emitting layer, an electron transfer layer, an electron injection layer and the like. When a voltage is applied between the two electrodes in such an organic light emitting device structure, holes and electrons are injected to the organic material layer from the first electrode and the second electrode, respectively, and when the injected holes and electrons meet, excitons are formed, and light emits when these excitons fall back to the ground state.

Development of new materials for such an organic light emitting device has been continuously required.

DISCLOSURE

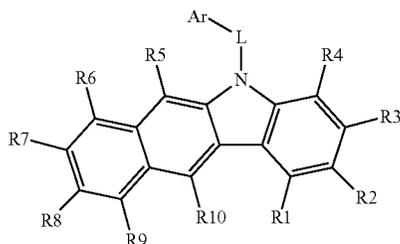
Technical Problem

The present application is directed to providing a compound, and an organic light emitting device including the same.

Technical Solution

One embodiment of the present application provides a compound represented by the following Chemical Formula 1.

[Chemical Formula 1]



2

wherein in Chemical Formula 1,

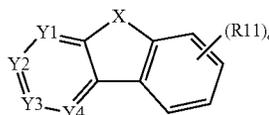
R1 to R4 are each independently hydrogen or deuterium, or adjacent groups of R1 to R4 may each independently bond to each other to form a ring,

R5 to R10 are each independently hydrogen; or deuterium;

L is a direct bond, a substituted or unsubstituted arylene group, or a substituted or unsubstituted heterocyclic group, and

Ar is represented by the following Chemical Formula 2,

[Chemical Formula 2]



wherein in Chemical Formula 2,

two of Y1 to Y4 are N, and the remaining two are C and CR,

X is O, S or CR'R'',

R' and R'' are a methyl group,

R and R11 are each independently hydrogen; deuterium; a halogen group; a nitrile group; a nitro group; a hydroxyl group; an aryloxy group; an alkylthioxy group; an arylthioxy group; an alkylsulfoxy group; an arylsulfoxy group; a silyl group; a boron group; a substituted or unsubstituted alkyl group; a substituted or unsubstituted cycloalkyl group; a substituted or unsubstituted alkenyl group; a substituted or unsubstituted aryl group; a substituted or unsubstituted aralkyl group; a substituted or unsubstituted alkylamine group; a substituted or unsubstituted aralkylamine group; a substituted or unsubstituted heteroarylamine group; a substituted or unsubstituted arylamine group; a substituted or unsubstituted arylheteroarylamine group; a substituted or unsubstituted arylphosphine group; or a substituted or unsubstituted heterocyclic group,

a is an integer of 1 to 4, and

when a is 2 or greater, two or more R11s are the same as or different from each other.

Another embodiment of the present application provides an organic light emitting device including a first electrode; a second electrode provided to face the first electrode; and one or more organic material layers provided between the first electrode and the second electrode, wherein one or more layers of the one or more organic material layers include the compound described above.

Advantageous Effects

An organic light emitting device using a compound according to one embodiment of the present application is capable of obtaining a low driving voltage, high light emission efficiency and/or a long lifetime.

DESCRIPTION OF DRAWINGS

FIG. 1 illustrates an organic light emitting device in which a substrate (1), a first electrode (2), a light emitting layer (3) and a second electrode (4) are consecutively laminated.

FIG. 2 illustrates an organic light emitting device in which a substrate (1), a first electrode (2), a hole injection layer (5), a hole transfer layer (6), a light emitting layer (3), an electron transfer layer (7) and a second electrode (4) are consecutively laminated.

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FIG. 3 is a graph showing an 1H-NMR value of Chemical Formula a according to one embodiment of the present specification, and FIG. 4 is a graph showing an MS value of Chemical Formula a.

FIG. 5 is a graph showing an 1H-NMR value of Chemical Formula d according to one embodiment of the present specification.

FIG. 6 is a graph showing an 1H-NMR value of Chemical Formula 5 according to one embodiment of the present specification.

FIG. 7 is a graph showing an 1H-NMR value of Chemical Formula 40 according to one embodiment of the present specification.

FIG. 8 is a graph showing an 1H-NMR value of Chemical Formula 451 according to one embodiment of the present specification.

FIG. 9 is a graph showing an 1H-NMR value of Chemical Formula 809 according to one embodiment of the present specification.

#### MODE FOR DISCLOSURE

Hereinafter, the present specification will be described in more detail.

One embodiment of the present specification provides a compound represented by Chemical Formula 1.

According to one embodiment of the present application, the compound represented by Chemical Formula 1 has, by having a core structure as above, an advantage of controlling triplet energy, and may exhibit long lifetime and high efficiency properties.

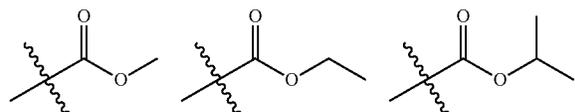
Examples of substituents in the present specification are described below, however, the substituents are not limited thereto.

The term "substitution" means a hydrogen atom bonding to a carbon atom of a compound is changed to another substituent, and the position of substitution is not limited as long as it is a position at which the hydrogen atom is substituted, that is, a position at which a substituent can substitute, and when two or more substituents substitute, the two or more substituents may be the same as or different from each other.

The term "substituted or unsubstituted" in the present specification means being unsubstituted or substituted with one or more substituents selected from the substituent group consisting of a halogen group; a nitrile group; a nitro group; a hydroxyl group; an alkyl group; a cycloalkyl group; an alkenyl group; an amine group; an aryl group; and a heterocyclic group, or being unsubstituted or substituted with a substituent from the above substituent group which is further substituted by one or more selected from the above substituent group.

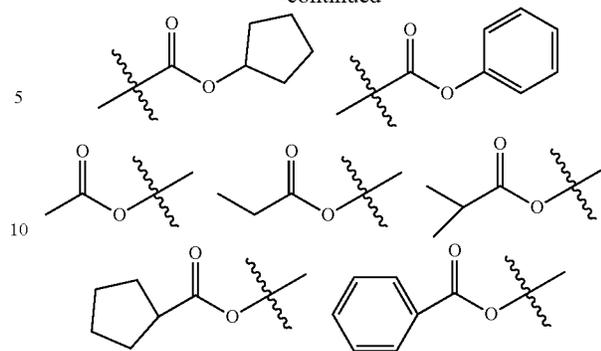
In the present specification, examples of the halogen group may include fluorine, chlorine, bromine or iodine.

In the present specification, the number of carbon atoms of the ester group is not particularly limited, but is preferably from 1 to 50. Specifically, compounds having the following structural formulae may be included, however, the ester group is not limited thereto.

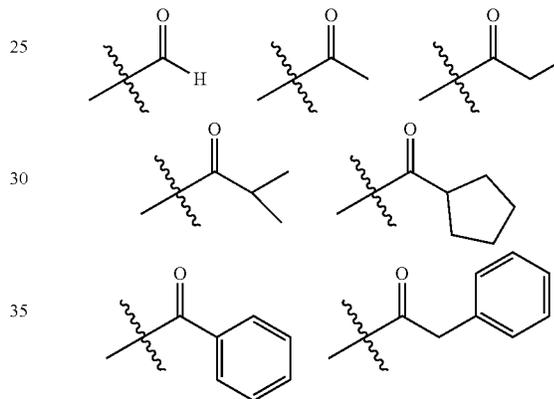


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In the present specification, the number of carbon atoms of the carbonyl group is not particularly limited, but is preferably from 1 to 50. Specifically, compounds having structures as below may be included, however, the carbonyl group is not limited thereto.



In the present specification, the alkyl group may be linear or branched, and although not particularly limited thereto, the number of carbon atoms is preferably from 1 to 50. Specific examples thereof may include methyl, ethyl, propyl, n-propyl, isopropyl, butyl, n-butyl, isobutyl, tert-butyl, sec-butyl, 1-methyl-butyl, 1-ethyl-butyl, pentyl, n-pentyl, isopentyl, neopentyl, tert-pentyl, hexyl, n-hexyl, 1-methyl-pentyl, 2-methylpentyl, 4-methyl-2-pentyl, 3,3-dimethyl-butyl, 2-ethylbutyl, heptyl, n-heptyl, 1-methylhexyl, cyclopentylmethyl, cyclohexylmethyl, octyl, n-octyl, tert-octyl, 1-methylheptyl, 2-ethylhexyl, 2-propylpentyl, n-nonyl, 2,2-dimethylheptyl, 1-ethyl-propyl, 1,1-dimethyl-propyl, isohexyl, 2-methylpentyl, 4-methylhexyl, 5-methylhexyl and the like, but are not limited thereto.

In the present specification, the cycloalkyl group is not particularly limited, but preferably has 3 to 60 carbon atoms, and specific examples thereof may include cyclopropyl, cyclobutyl, cyclopentyl, 3-methylcyclopentyl, 2,3-dimethylcyclopentyl, cyclohexyl, 3-methylcyclohexyl, 4-methylcyclohexyl, 2,3-dimethylcyclohexyl, 3,4,5-trimethylcyclohexyl, 4-tert-butylcyclohexyl, cycloheptyl, cyclooctyl and the like, but are not limited thereto.

In the present specification, the alkoxy group may be linear, branched or cyclic. The number of carbon atoms of the alkoxy group is not particularly limited, but is preferably from 1 to 20. Specific examples thereof may include methoxy, ethoxy, n-propoxy, isopropoxy, i-propyloxy, n-bu-

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toxy, isobutoxy, tert-butoxy, sec-butoxy, n-pentyloxy, neopentyloxy, isopentyloxy, n-hexyloxy, 3,3-dimethylbutyloxy, 2-ethylbutyloxy, n-octyloxy, n-nonyloxy, n-decyloxy, benzoyloxy, p-methylbenzyloxy and the like, but are not limited thereto.

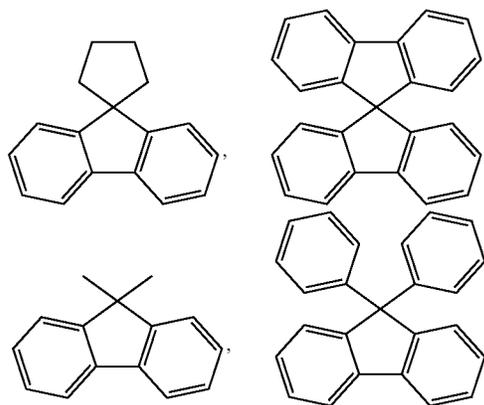
In the present specification, the alkenyl group may be linear or branched, and although not particularly limited thereto, the number of carbon atoms is preferably from 2 to 40. Specific examples thereof may include vinyl, 1-propenyl, isopropenyl, 1-butenyl, 2-butenyl, 3-butenyl, 1-pentenyl, 2-pentenyl, 3-pentenyl, 3-methyl-1-butenyl, 1,3-butadienyl, allyl, 1-phenylvinyl-1-yl, 2-phenylvinyl-1-yl, 2,2-diphenylvinyl-1-yl, 2-phenyl-2-(naphthyl-1-yl)vinyl-1-yl, 2,2-bis(diphenyl-1-yl)vinyl-1-yl, a stilbenyl group, a styrenyl group and the like, but are not limited thereto.

In the present specification, when the aryl group is a monocyclic aryl group, the number of carbon atoms is not particularly limited, but is preferably from 6 to 25. Specific examples of the monocyclic aryl group may include a phenyl group, a biphenyl group, a terphenyl group and the like, but are not limited thereto.

When the aryl group is a polycyclic aryl group, the number of carbon atoms is not particularly limited, but is preferably from 10 to 24. Specific examples of the polycyclic aryl group may include a naphthyl group, an anthracenyl group, a phenanthryl group, a pyrenyl group, a perylenyl group, a chrysenyl group, a fluorenyl group and the like, but are not limited thereto.

In the present specification, the fluorenyl group may be substituted, and adjacent substituents may bond to each other to form a ring.

When the fluorenyl group is substituted,



and the like may be included. However, the compound is not limited thereto.

In the present specification, the heterocyclic group is a group including one or more atoms that are not carbon, that is, heteroatoms, and specifically, the heteroatom may include one or more atoms selected from the group consisting of O, N, Se, S and the like. The number of carbon atoms of the heterocyclic group is not particularly limited, but is preferably from 2 to 60. Examples of the heterocyclic group may include a thiophene group, a furan group, a pyrrole group, an imidazole group, a thiazole group, an oxazole group, an oxadiazole group, a triazole group, a pyridyl group, a bipyridyl group, a pyrimidyl group, a triazine group, a triazole group, an acridyl group, a pyridazine group, a pyrazinyl group, a quinolinyl group, a quinazoline group, a quinoxalinyl group, a phthalazinyl group, a pyridopyrimidi-

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nyl group, a pyridopyrazinyl group, a pyrazinopyrazinyl group, an isoquinoline group, an indole group, a carbazole group, a benzoxazole group, a benzimidazole group, a benzothiazole group, a benzocarbazole group, a benzothio-  
5 phene group, a dibenzothiophene group, a benzofuranyl group, a phenanthroline group, a thiazolyl group, an isoxazolyl group, an oxadiazolyl group, a thiadiazolyl group, a benzothiazolyl group, a phenothiazinyl group, a dibenzofuranyl group and the like, but are not limited thereto.

In the present specification, descriptions on the aryl group provided above may be applied to the aromatic hydrocarbon ring except for those that are divalent.

In the present specification, descriptions on the heterocyclic group provided above may be applied to the heteroring  
15 except for those that are divalent.

In the present specification, descriptions on the aryl group provided above may be applied to the aryl group in the aryloxy group, the arylthioxy group, the arylsulfoxy group, the arylphosphine group, the aralkyl group, the aralkylamine group, the aralkenyl group and the arylamine group.

In the present specification, descriptions on the alkyl group provided above may be applied to the alkyl group in the alkylthioxy group, the alkylsulfoxy group, the aralkyl group, the aralkylamine group and the alkylamine group.

In the present specification, descriptions on the heterocyclic group provided above may be applied to the heteroaryl group, and the heteroaryl group in the heteroarylamine group.

In the present specification, descriptions on the alkenyl group provided above may be applied to the alkenyl group in the aralkenyl group.

In the present specification, descriptions on the aryl group provided above may be applied to the arylene except for  
35 being divalent.

In the present specification, descriptions on the heterocyclic group provided above may be applied to the heteroarylene except for being divalent.

In the present specification, adjacent groups bonding to each other to form a ring means adjacent groups bonding to each other to form a substituted or unsubstituted aliphatic hydrocarbon ring; a substituted or unsubstituted aromatic hydrocarbon ring; a substituted or unsubstituted aliphatic heteroring; or a substituted or unsubstituted aromatic heteroring.  
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In the present specification, the aliphatic hydrocarbon ring means, as a ring that is not aromatic, a ring formed only with carbon and hydrogen atoms.

In the present specification, examples of the aromatic hydrocarbon ring includes a phenyl group, a naphthyl group, an anthracenyl group and the like, but are not limited thereto.

In the present specification, the aliphatic heteroring means an aliphatic ring including one or more of heteroatoms.

In the present specification, the aromatic heteroring means an aromatic ring including one or more of heteroatoms.

In the present specification, the aliphatic hydrocarbon ring, the aromatic hydrocarbon ring, the aliphatic heteroring and the aromatic heteroring may be monocyclic or polycyclic.  
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In the present specification, an "adjacent" group may mean a substituent substituting an atom directly linked to an atom substituted by the corresponding substituent, a substituent sterically most closely positioned to the corresponding substituent, or another substituent substituting an atom substituted by the corresponding substituent. For example, two substituents substituting ortho positions in a benzene  
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ring, and two substituents substituting the same carbon in an aliphatic ring may be interpreted as groups "adjacent" to each other.

In the present specification, adjacent groups bonding to each other to form a ring means, as described above, adjacent groups bonding to each other to a 5-membered to 8-membered hydrocarbon ring or a 5-membered to 8-membered heteroring, and the ring may be monocyclic or polycyclic, aliphatic, aromatic, or a fused form thereof, but is not limited thereto.

According to one embodiment of the present application, R1 to R10 are each independently hydrogen; deuterium; a halogen group; a nitrile group; a nitro group; a hydroxyl group; an aryloxy group; an alkylthioxy group; an arylthioxy group; an alkylsulfoxy group; an arylsulfoxy group; a silyl group; a boron group; a substituted or unsubstituted alkyl group; a substituted or unsubstituted cycloalkyl group; a substituted or unsubstituted alkenyl group; a substituted or unsubstituted aryl group; a substituted or unsubstituted aralkyl group; a substituted or unsubstituted alkylamine group; a substituted or unsubstituted aralkylamine group; a substituted or unsubstituted arylamine group; or a substituted or unsubstituted arylphosphine group.

According to one embodiment of the present application, R1 to R10 are each independently hydrogen; or deuterium.

According to one embodiment of the present application, R1 to R10 are hydrogen.

According to one embodiment of the present application, adjacent groups of R1 to R4 may each independently bond to each other to form a ring.

According to one embodiment of the present application, adjacent groups of R1 to R4 may each independently bond to each other to form an aryl group having 6 to 60 carbon atoms.

According to one embodiment of the present application, adjacent groups of R1 to R4 may each independently bond to each other to form an aryl group having 6 to 30 carbon atoms.

According to one embodiment of the present application, adjacent groups of R1 to R4 may each independently bond to each other to form an aryl group having 6 to 15 carbon atoms.

According to one embodiment of the present application, adjacent groups of R1 to R4 may each independently bond to each other to form a phenyl group.

According to one embodiment of the present application, R1 and R2; R2 and R3; or R3 and R4 may bond to each other to form a phenyl group.

According to one embodiment of the present application, L is a direct bond; a substituted or unsubstituted arylene group, or a substituted or unsubstituted heterocyclic group.

According to one embodiment of the present application, L is a direct bond; a substituted or unsubstituted arylene group having 6 to 60 carbon atoms, or a substituted or unsubstituted heterocyclic group having 2 to 60 carbon atoms.

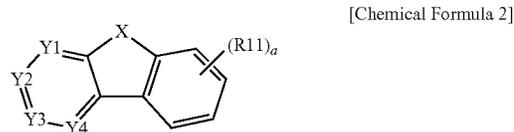
According to one embodiment of the present application, L is a direct bond; a substituted or unsubstituted arylene group having 6 to 30 carbon atoms, or a substituted or unsubstituted heterocyclic group having 2 to 30 carbon atoms.

According to one embodiment of the present application, L is a direct bond; a substituted or unsubstituted arylene group having 6 to 15 carbon atoms, or a substituted or unsubstituted heterocyclic group having 2 to 15 carbon atoms.

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According to one embodiment of the present application, L is a direct bond; a substituted or unsubstituted arylene group having 6 to 15 carbon atoms, or a substituted or unsubstituted heterocyclic group having 2 to 15 carbon atoms including at least one N.

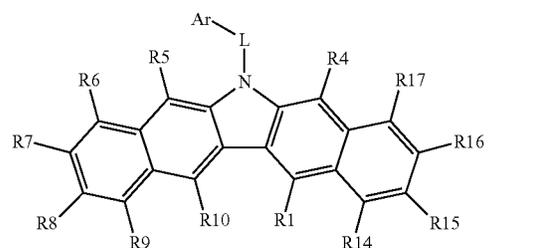
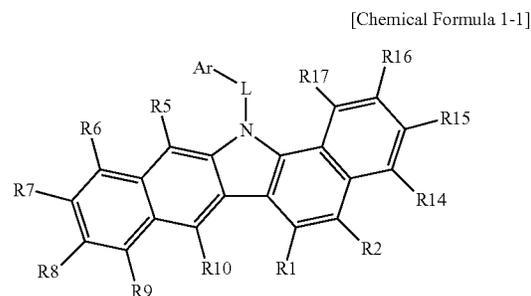
According to one embodiment of the present application, Ar is represented by the following Chemical Formula 2.



In Chemical Formula 2, two of Y1 to Y4 are N, and the remaining two are C which is a bonding site to L and CR,

X is O, S or CR'R", and R and R11 are each independently hydrogen; deuterium; a halogen group; a nitrile group; a nitro group; a hydroxyl group; an aryloxy group; an alkylthioxy group; an arylthioxy group; an alkylsulfoxy group; an arylsulfoxy group; a silyl group; a boron group; a substituted or unsubstituted alkyl group; a substituted or unsubstituted cycloalkyl group; a substituted or unsubstituted alkenyl group; a substituted or unsubstituted aryl group; a substituted or unsubstituted aralkyl group; a substituted or unsubstituted alkylamine group; a substituted or unsubstituted aralkylamine group; a substituted or unsubstituted heteroarylamine group; a substituted or unsubstituted arylamine group; a substituted or unsubstituted arylheteroarylamine group; a substituted or unsubstituted arylphosphine group; or a substituted or unsubstituted heterocyclic group, R' and R" are a methyl group, a is an integer of 1 to 4, and when a is 2 or greater, two or more R11s are the same as or different from each other.

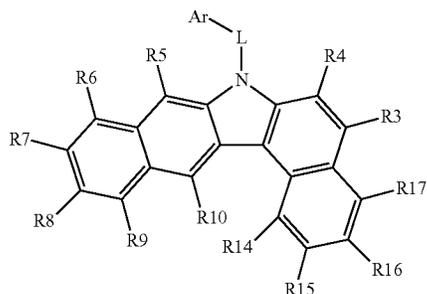
According to one embodiment of the present application, Chemical Formula 1 is represented by any one selected from among the following Chemical Formulae 1-1 to 1-3.



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[Chemical Formula 1-3]



In Chemical Formulae 1-1 to 1-3,

R1 to R10, Ar and L have the same definitions as in Chemical Formulae 1, and

R14 to R17 are each independently hydrogen; or deuterium.

According to one embodiment of the present specification, Y1 and Y3 are N, Y2 is C, and Y4 is CR.

According to one embodiment of the present specification, Y1 and Y3 are N, Y4 is C, and Y2 is CR.

According to one embodiment of the present specification, Y1 and Y4 are N, Y2 is C, and Y3 is CR.

According to one embodiment of the present specification, Y1 and Y4 are N, Y3 is C, and Y2 is CR.

According to one embodiment of the present specification, Y1 and Y4 are N, Y3 is C, and Y2 is CR.

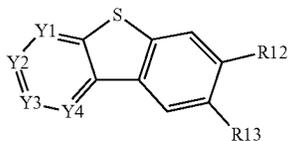
According to one embodiment of the present specification, Y2 and Y4 are N, Y1 is C, and Y3 is CR.

According to one embodiment of the present specification, R is a substituted or unsubstituted aryl group; or a substituted or unsubstituted heterocyclic group.

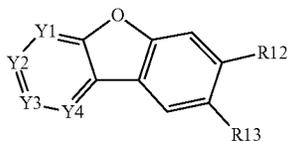
According to one embodiment of the present specification, R is a substituted or unsubstituted aryl group having 6 to 30 carbon atoms; or a substituted or unsubstituted heterocyclic group having 3 to 30 carbon atoms.

According to one embodiment of the present specification, Chemical Formula 2 is represented by any one selected from among the following Chemical Formulae 2-1 to 2-3.

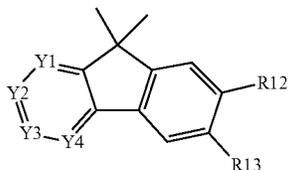
[Chemical Formula 2-1]



[Chemical Formula 2-2]



[Chemical Formula 2-3]

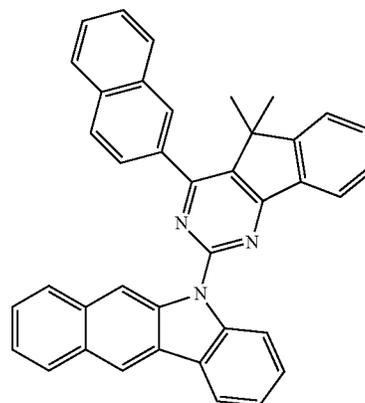
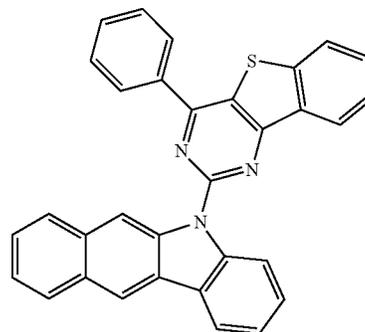
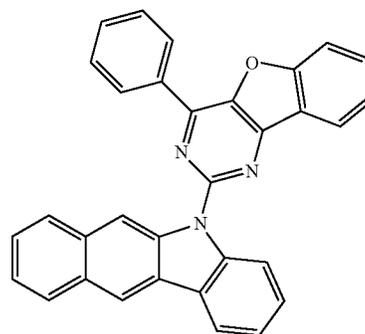


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In Chemical Formulae 2-1 to 2-3,

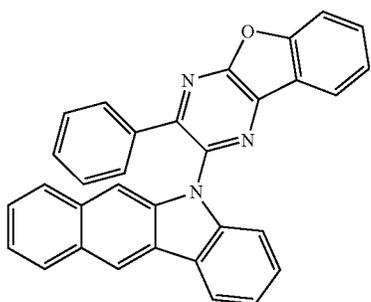
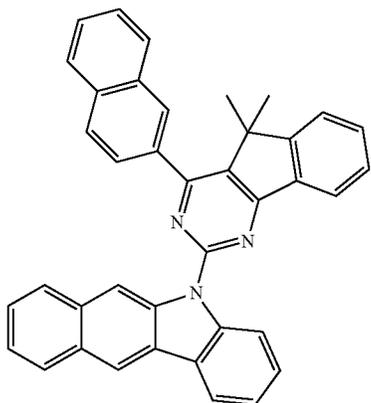
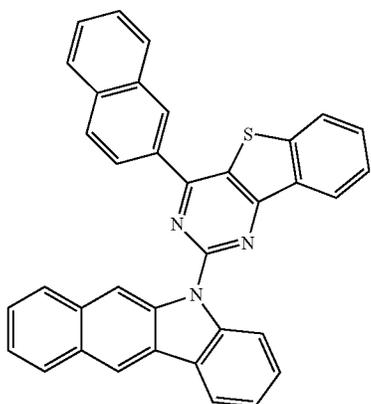
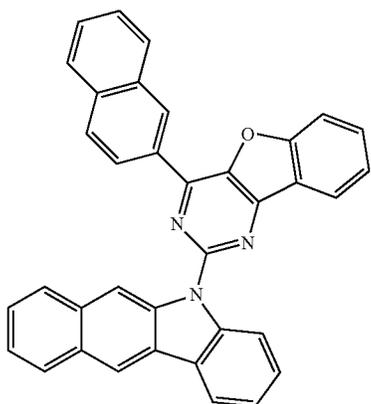
Y1 to Y4 have the same definitions as above, and R12 and R13 each independently have the same definition as R11.

According to one embodiment of the present specification, the compound represented by Chemical Formula 1 is any one selected from among the following structural formulae.



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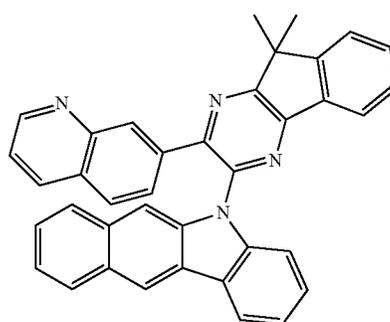
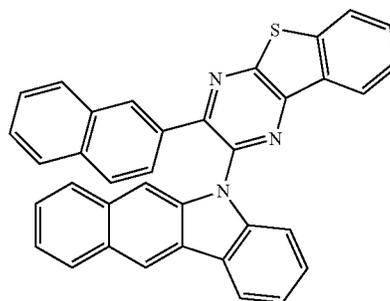
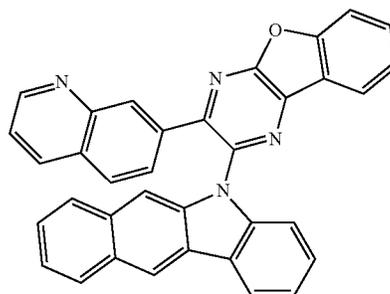
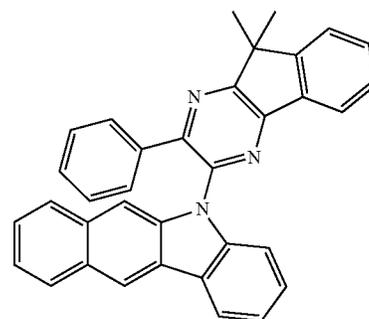
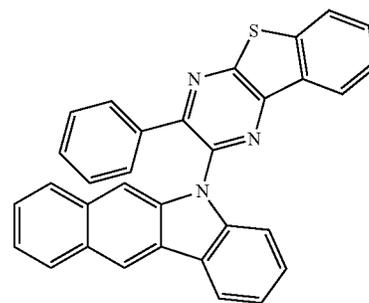
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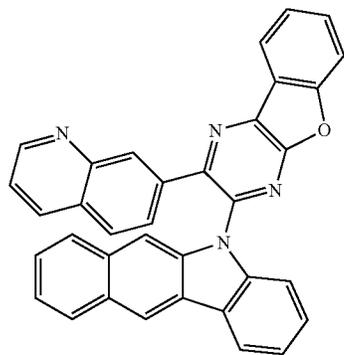
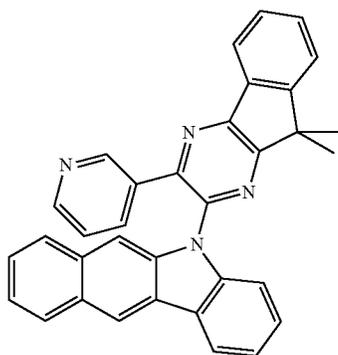
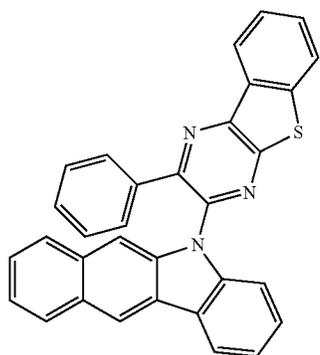
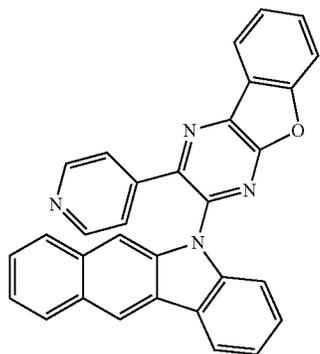
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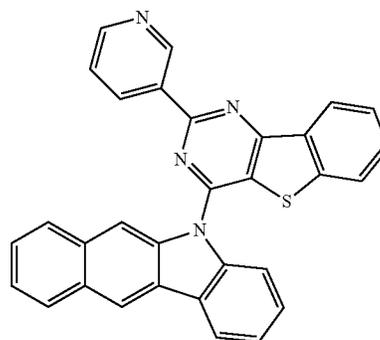
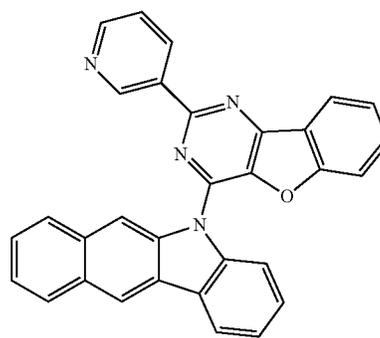
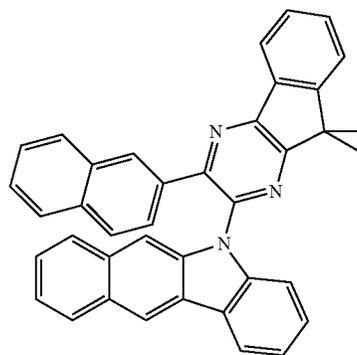
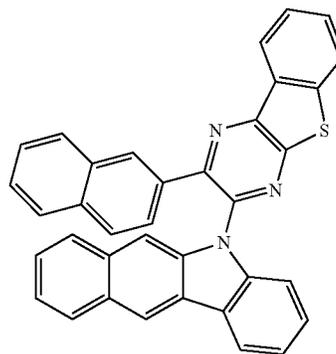
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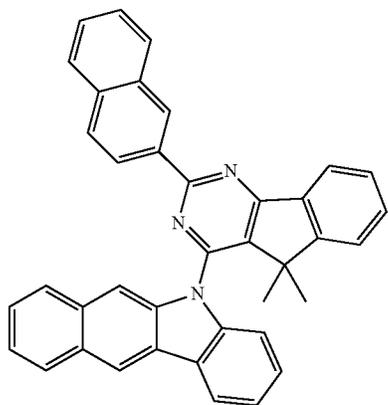
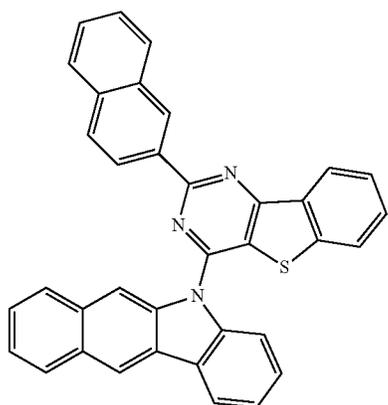
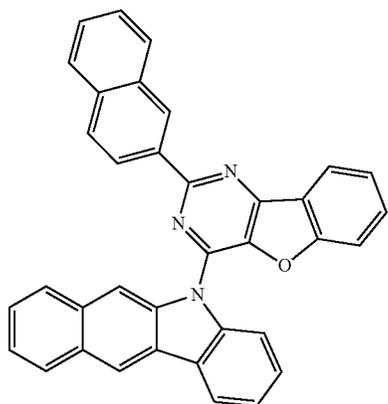
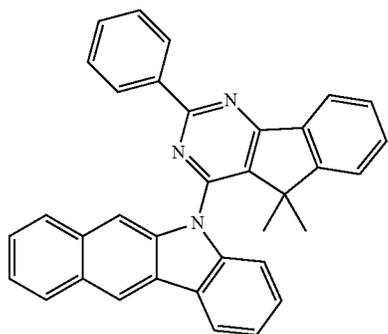
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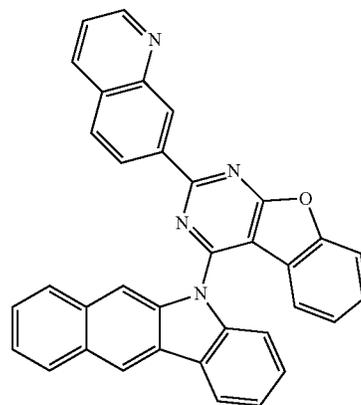
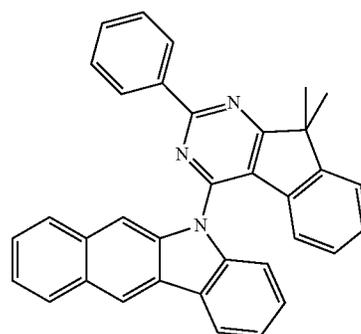
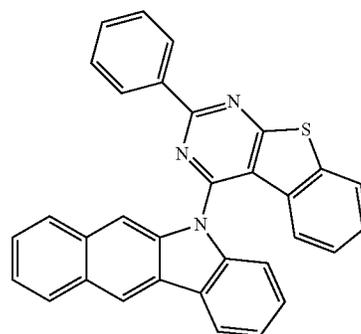
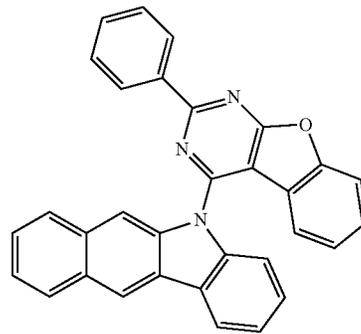
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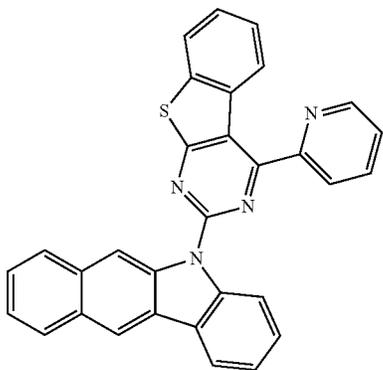
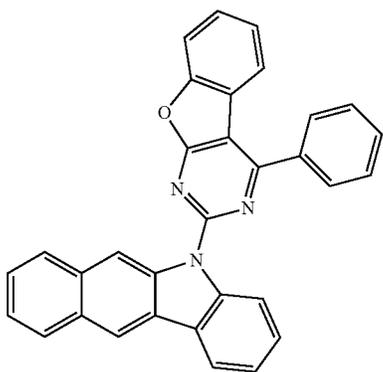
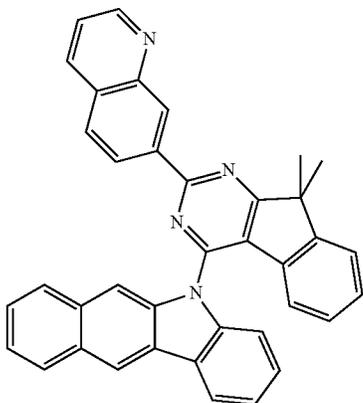
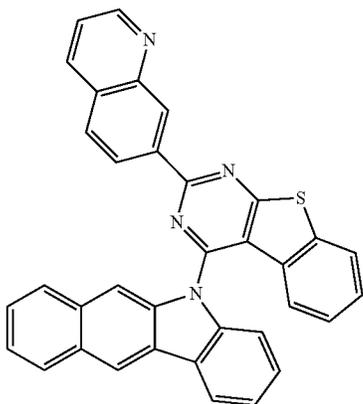
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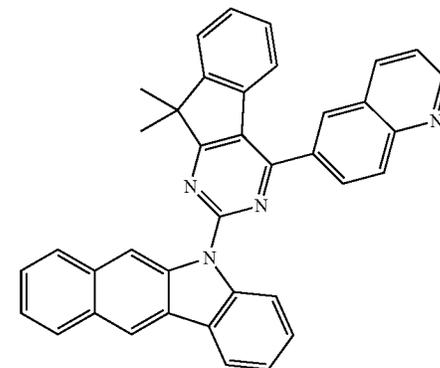
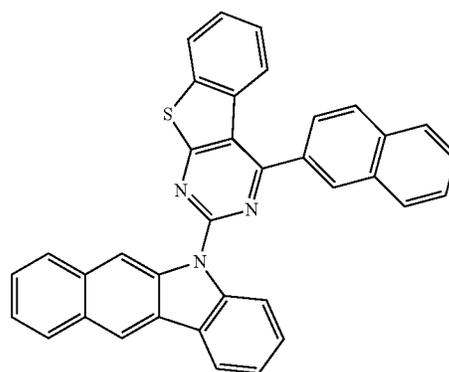
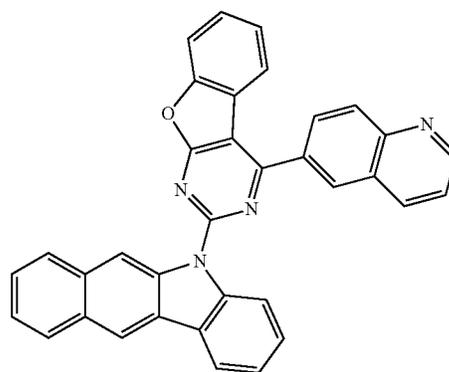
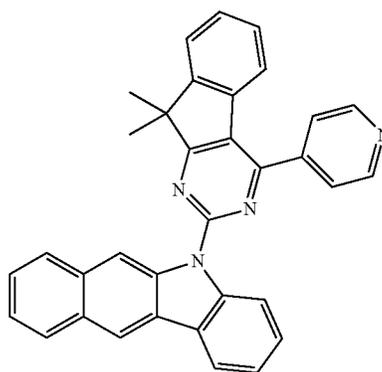
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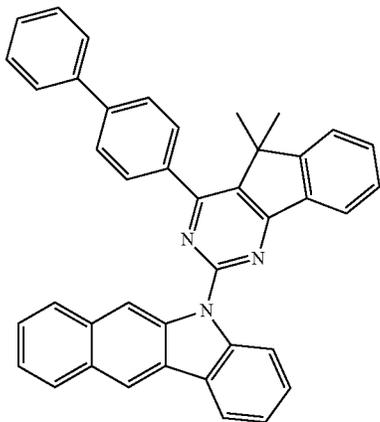
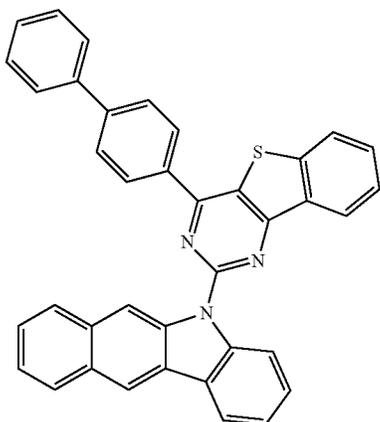
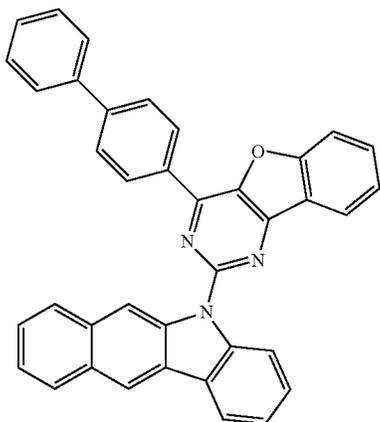
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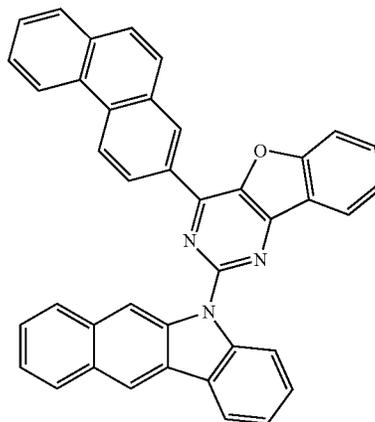


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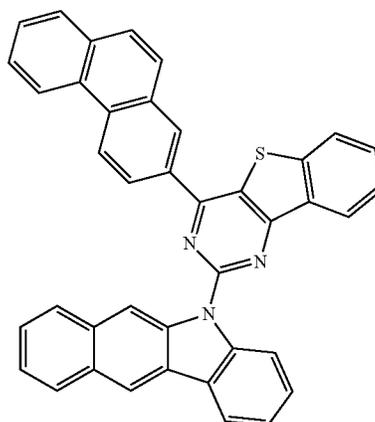
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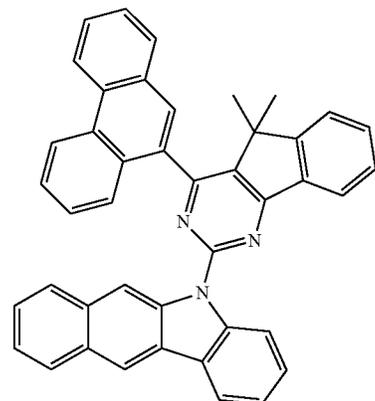


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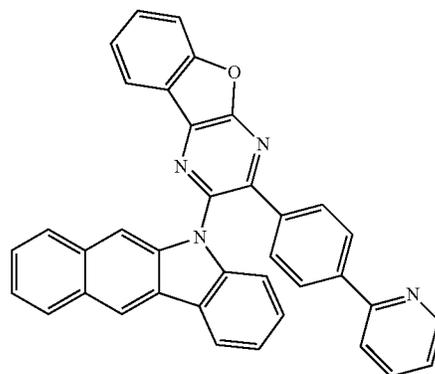
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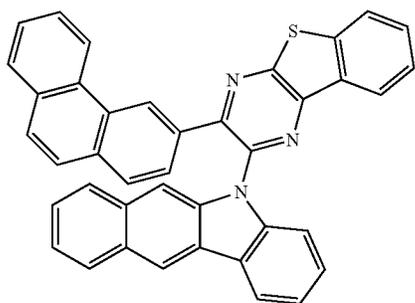
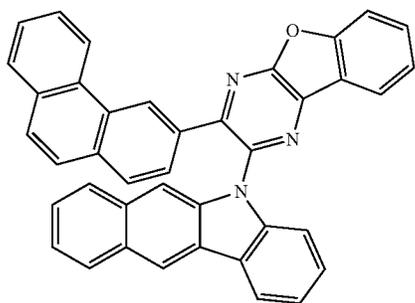
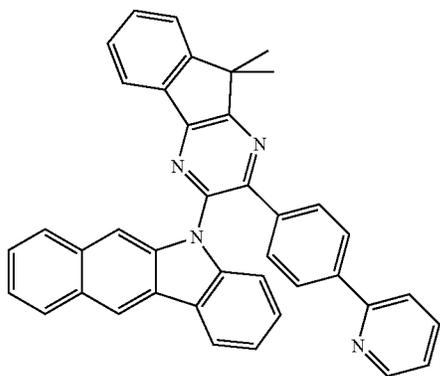
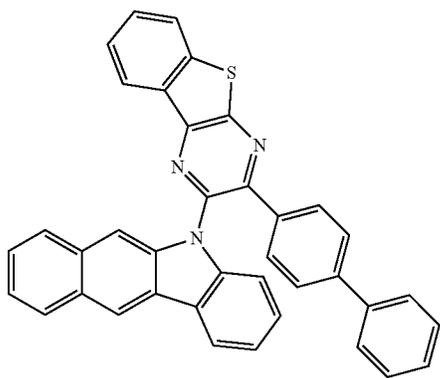
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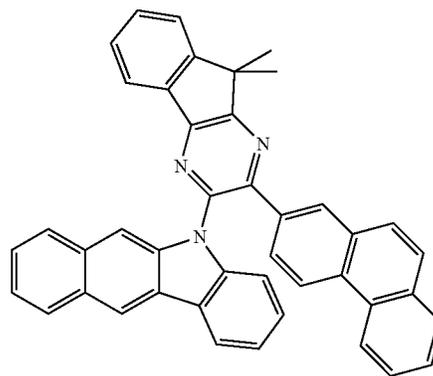
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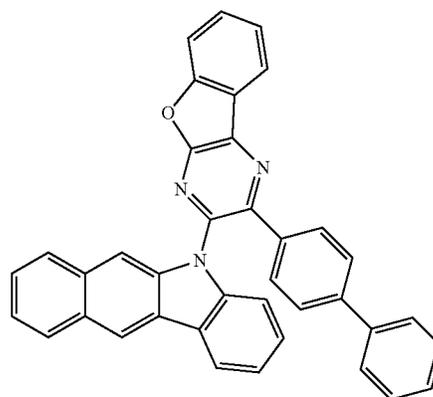
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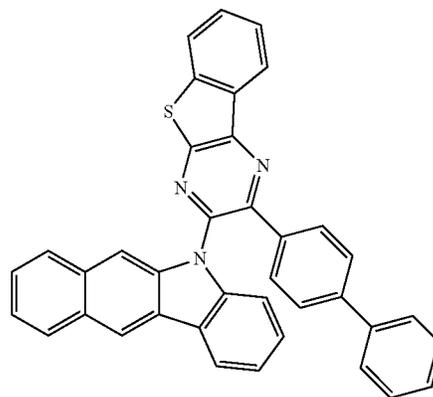
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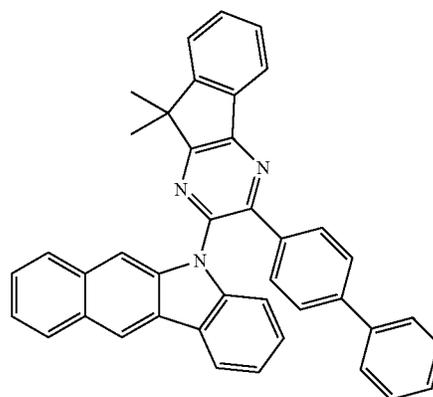
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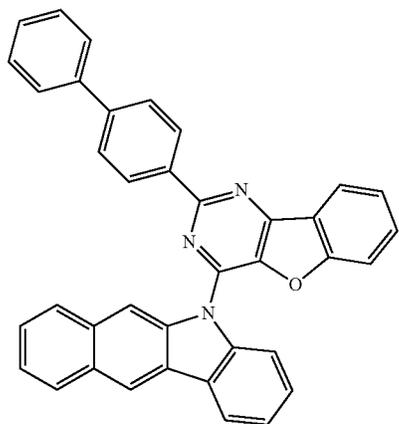
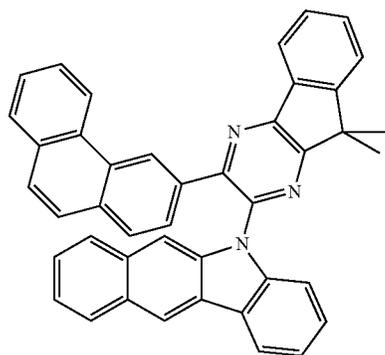
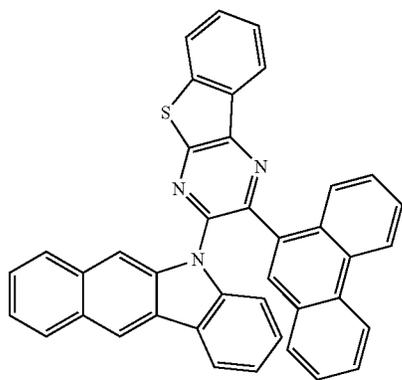
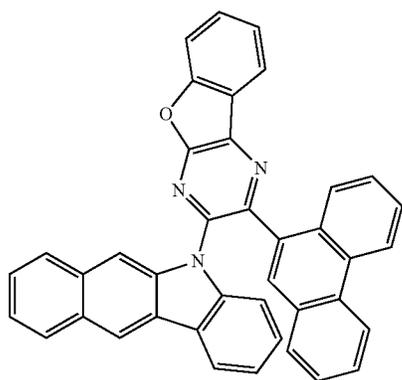
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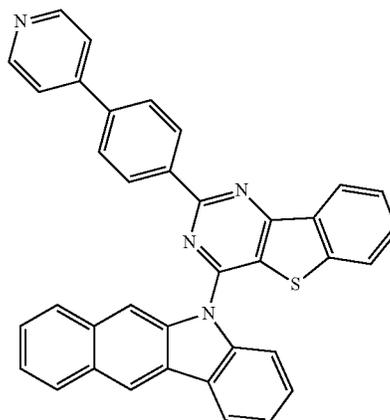
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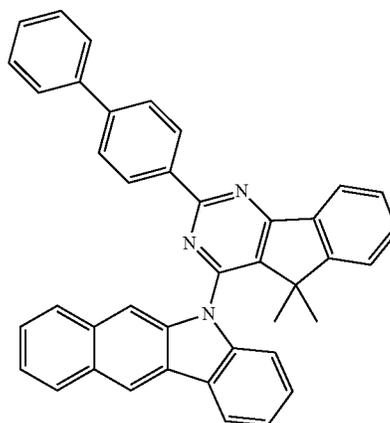
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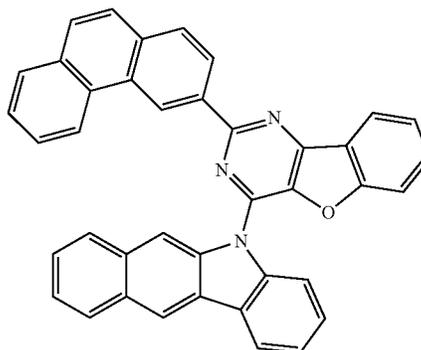
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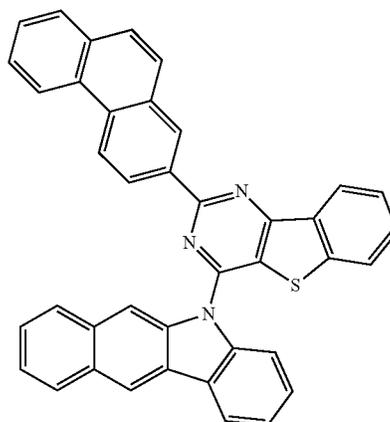
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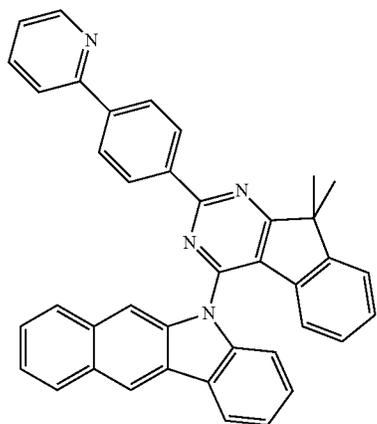
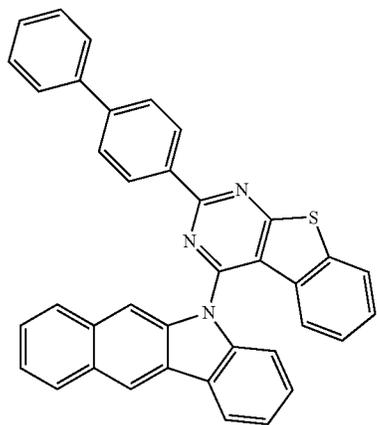
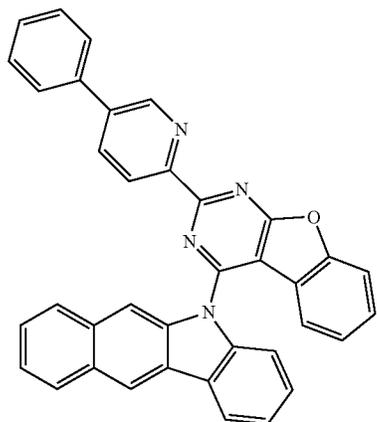
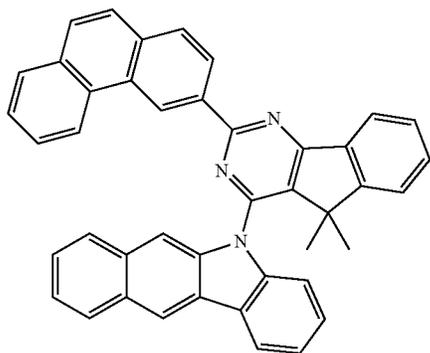
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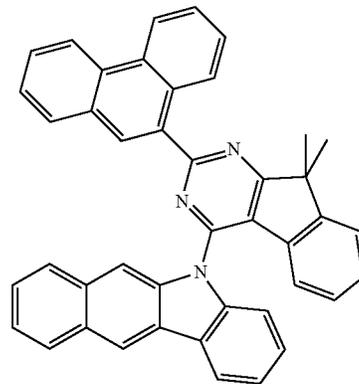
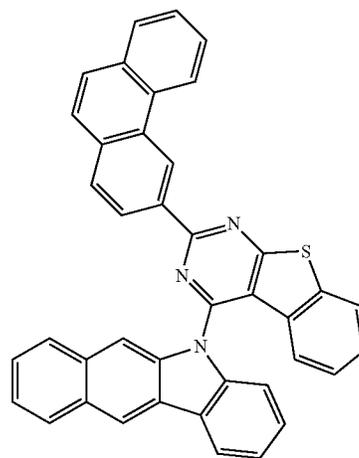
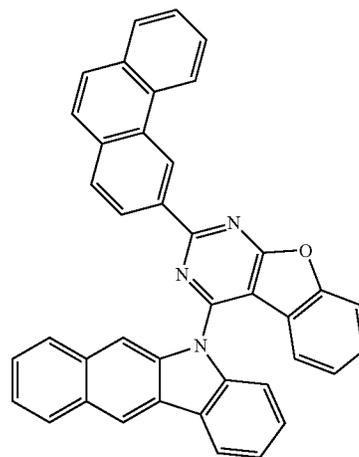
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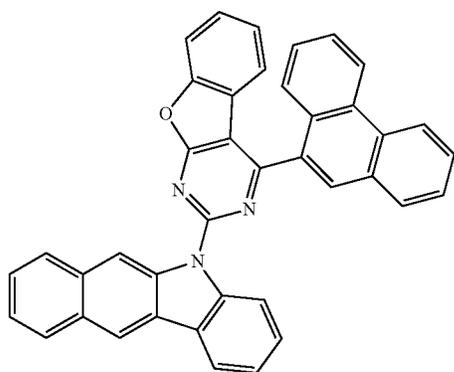
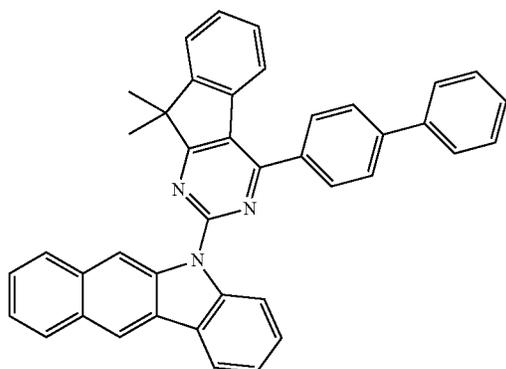
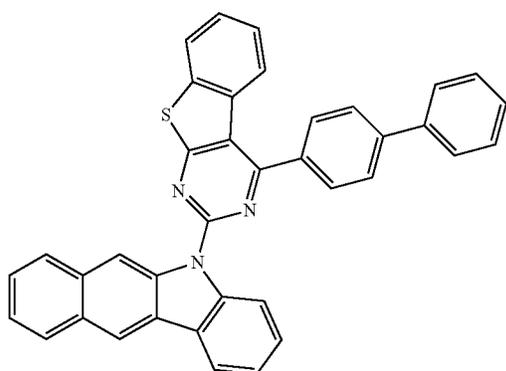
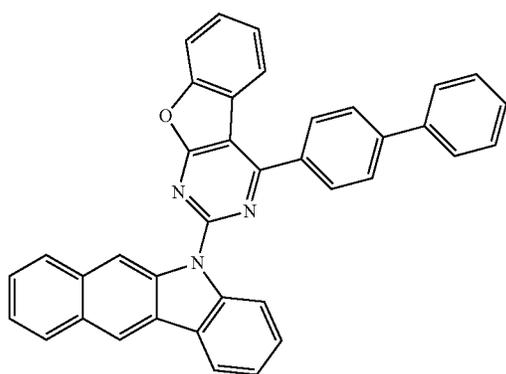
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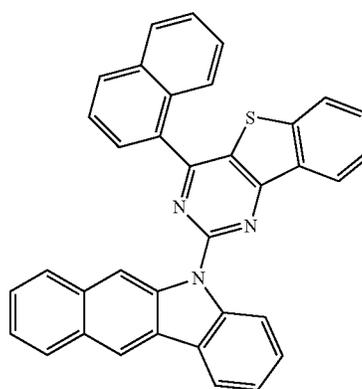
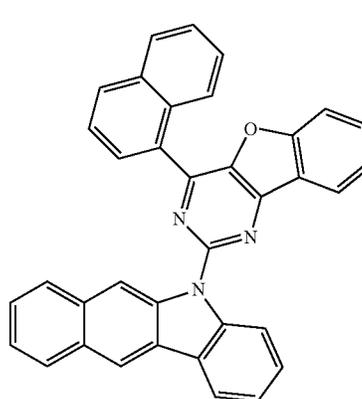
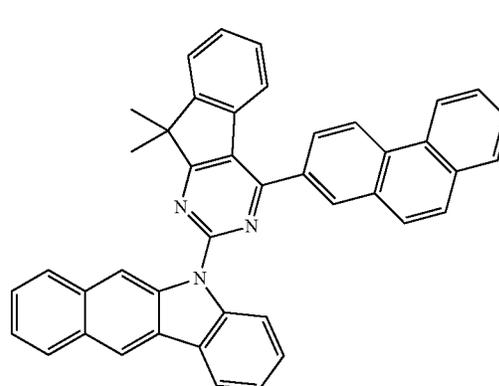
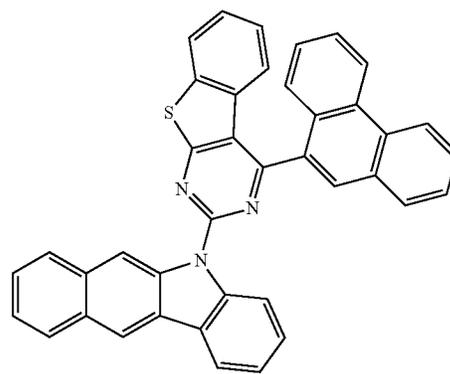
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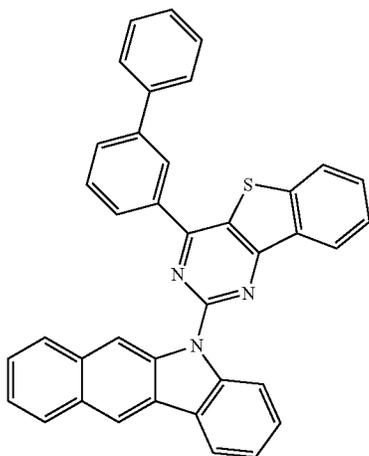
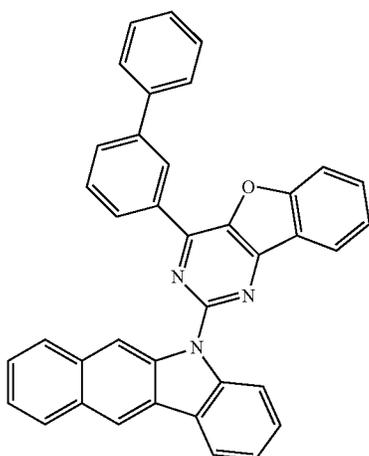
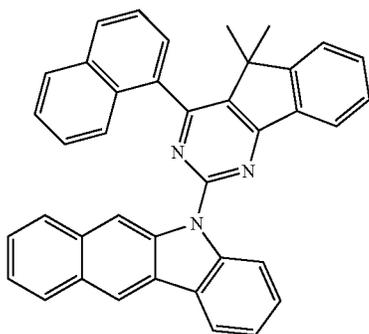
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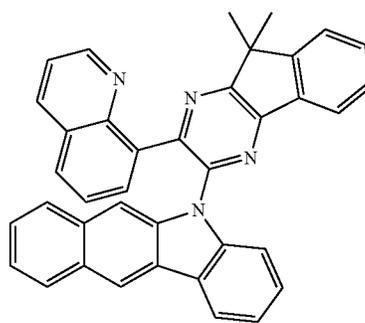
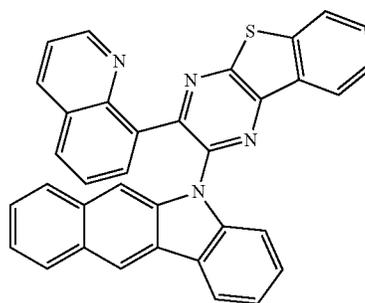
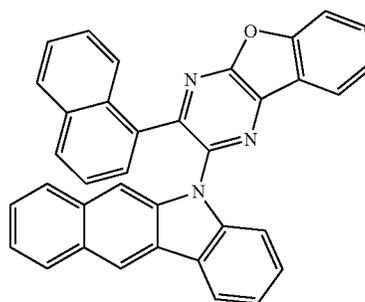
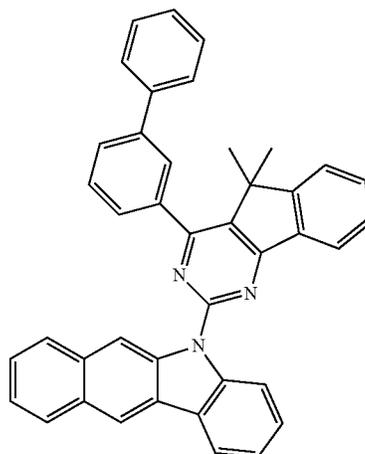
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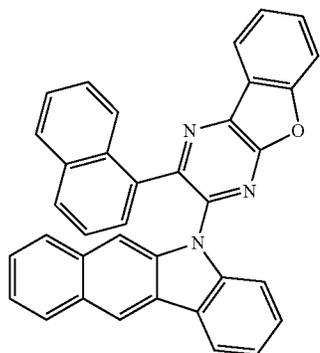
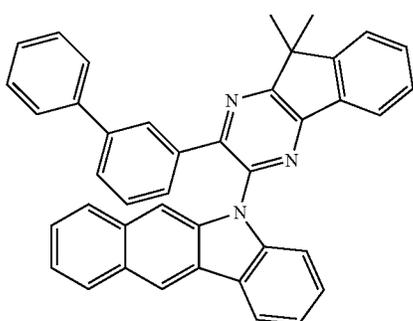
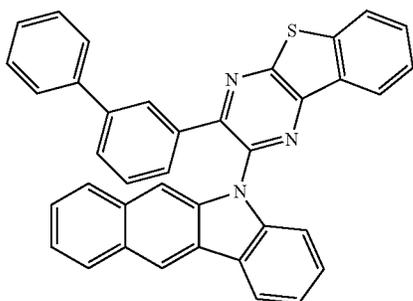
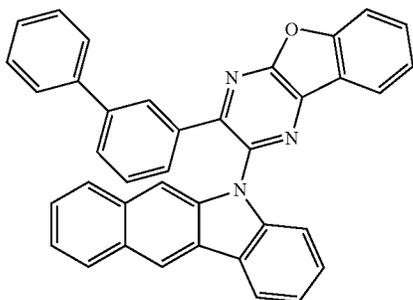
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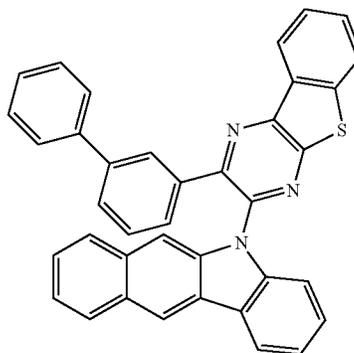
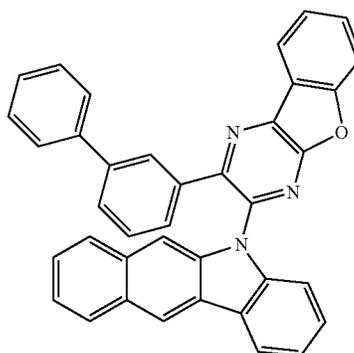
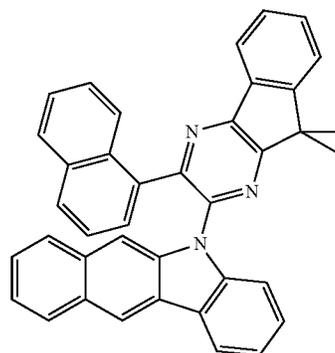
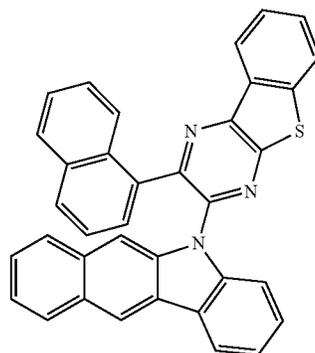
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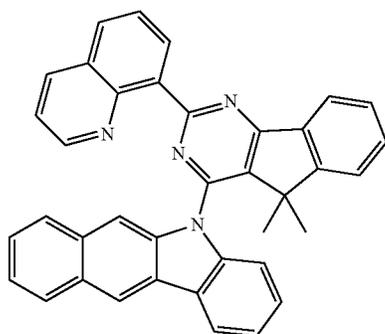
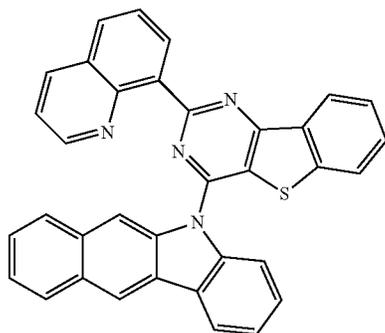
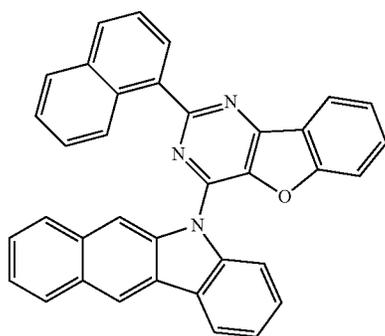
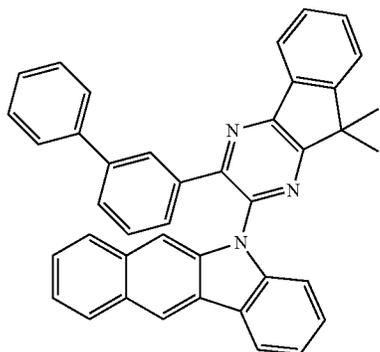
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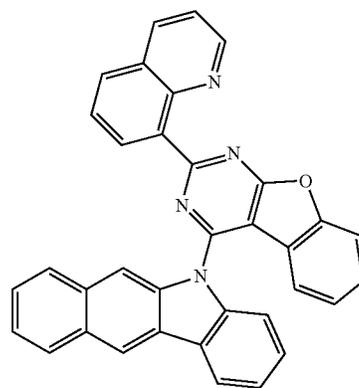
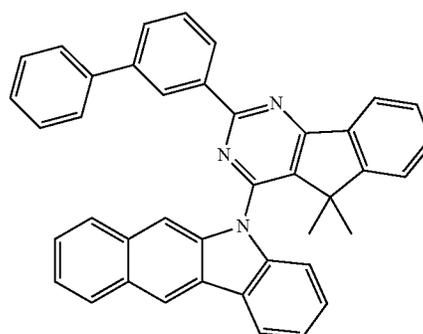
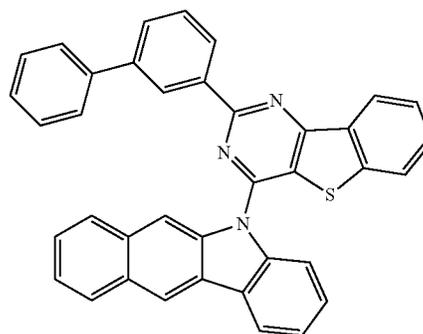
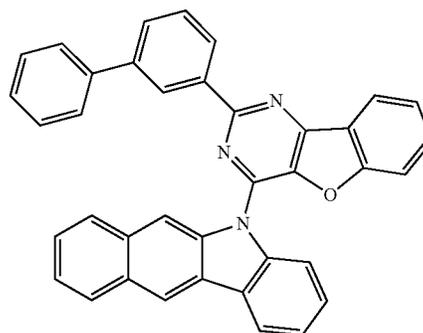
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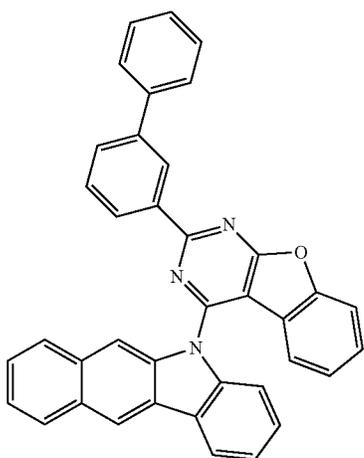
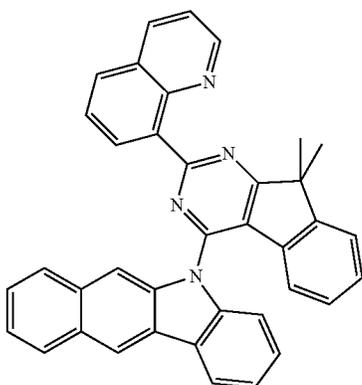
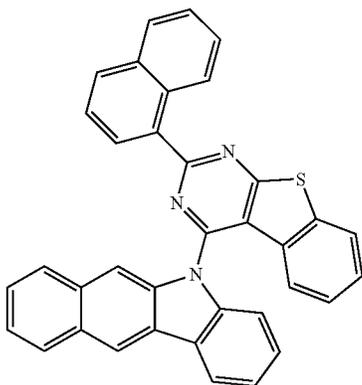
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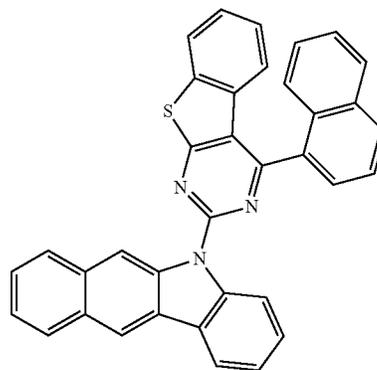
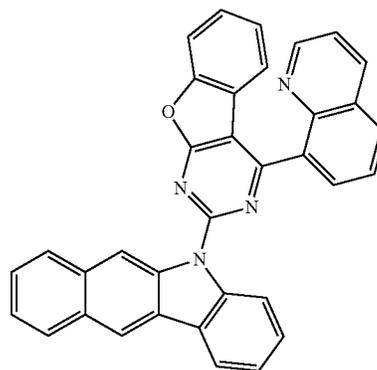
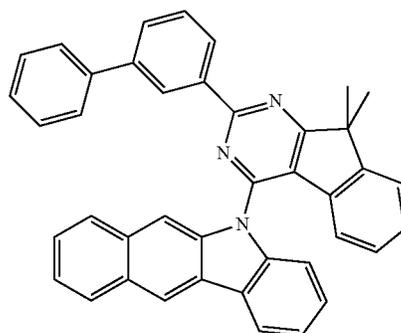
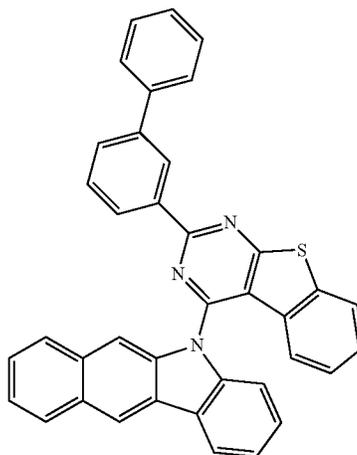
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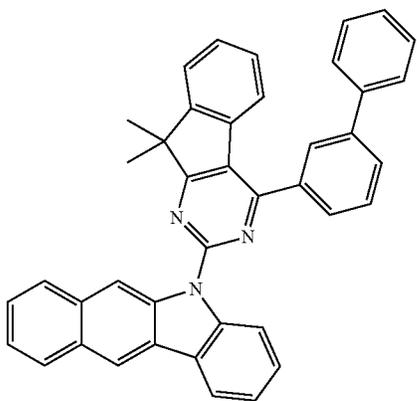
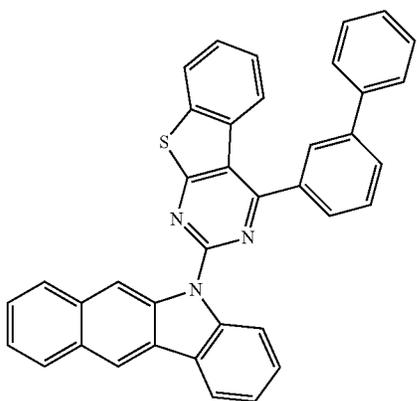
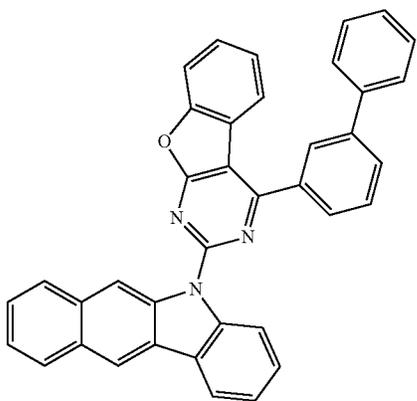
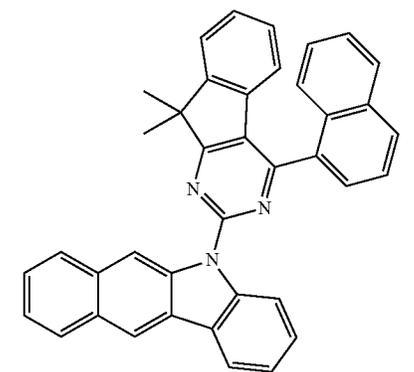
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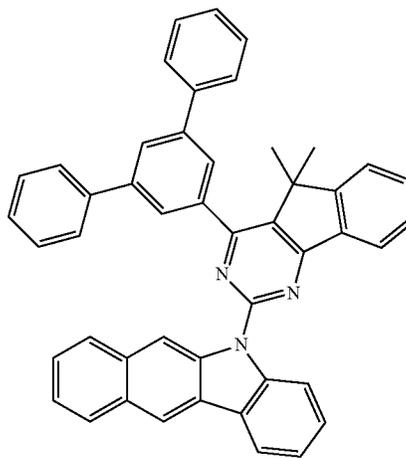
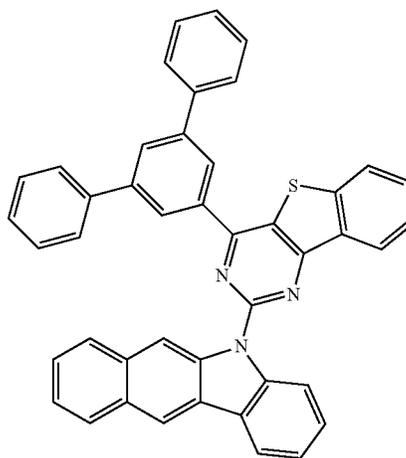
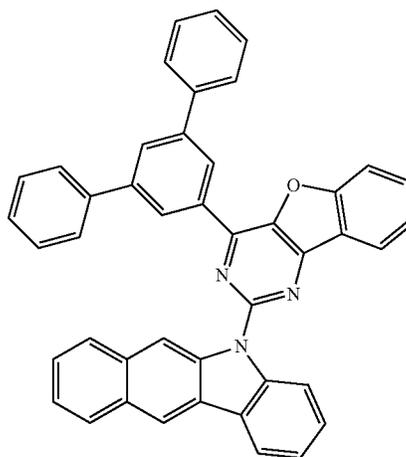
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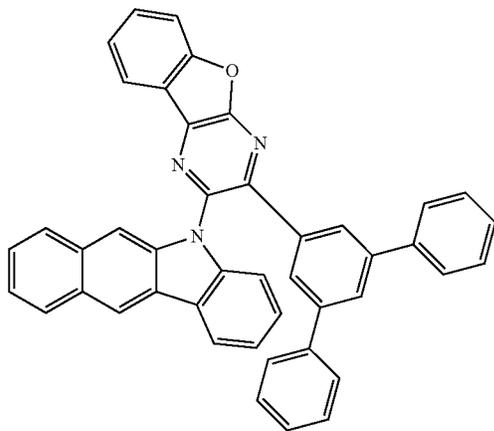
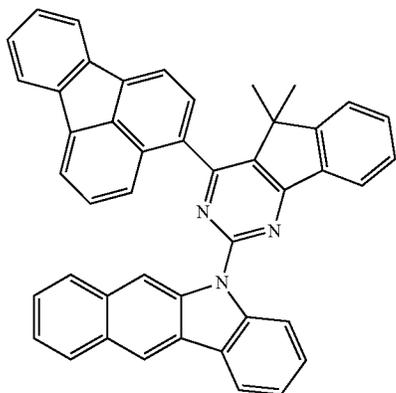
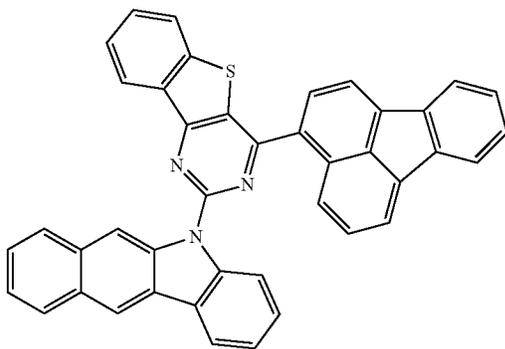
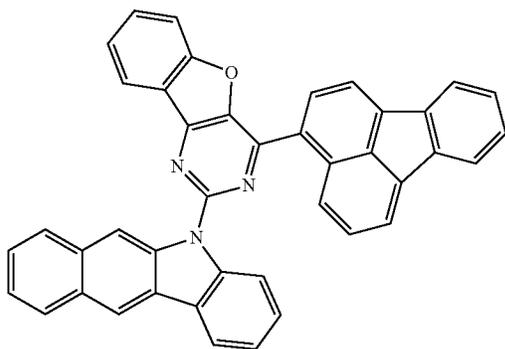
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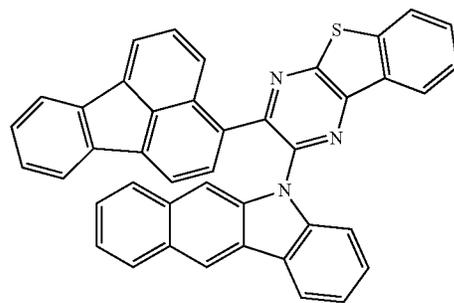
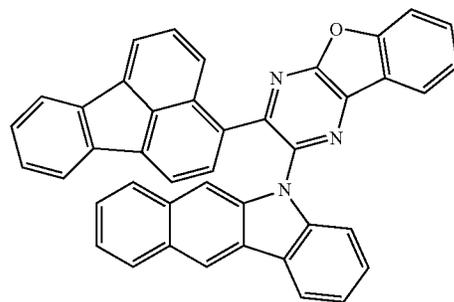
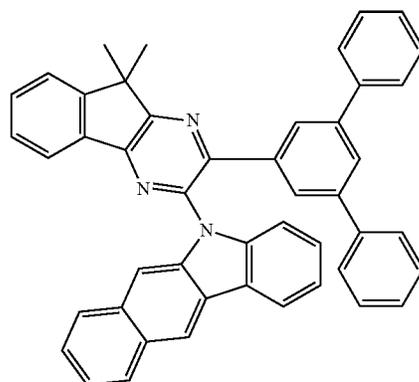
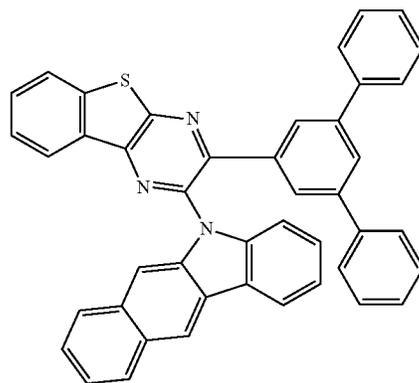
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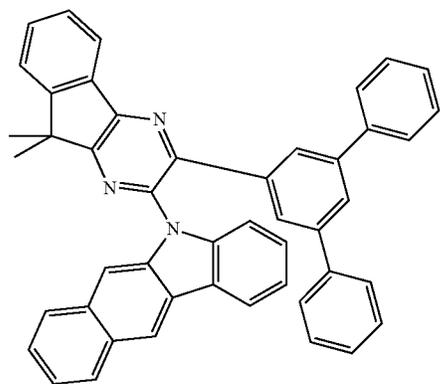
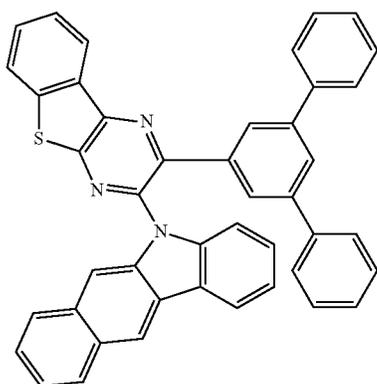
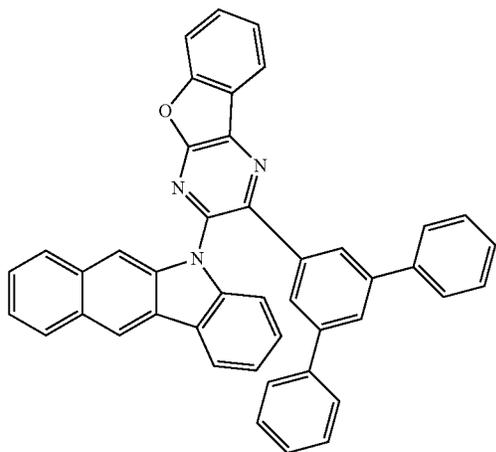
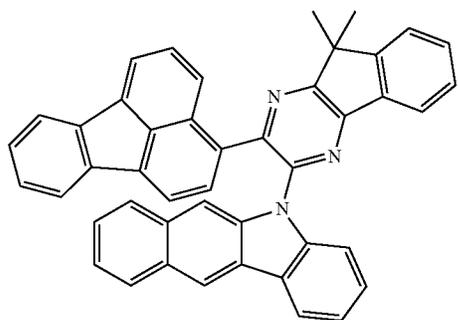
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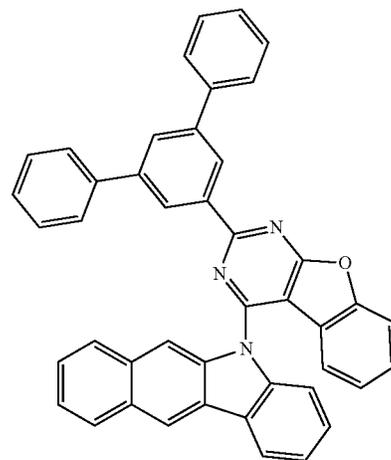
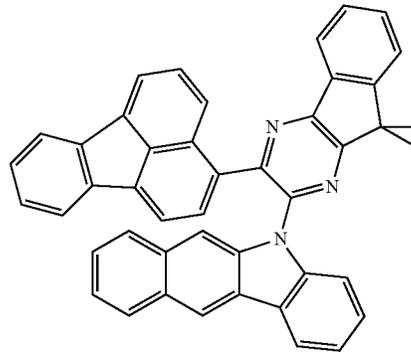
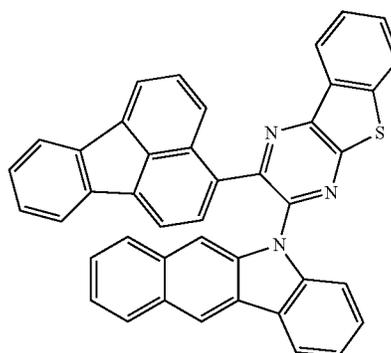
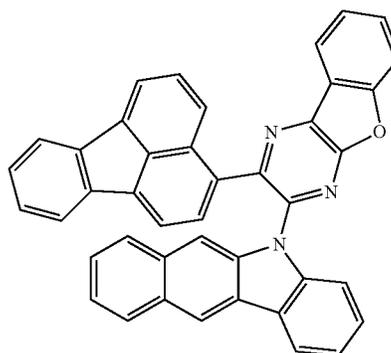
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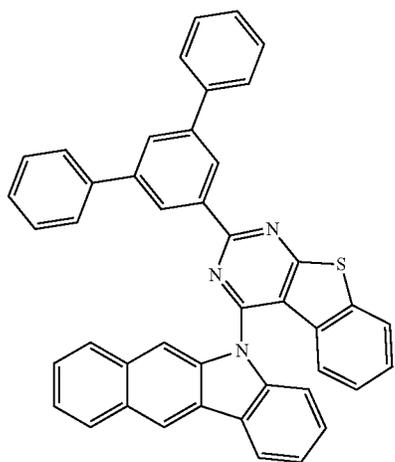
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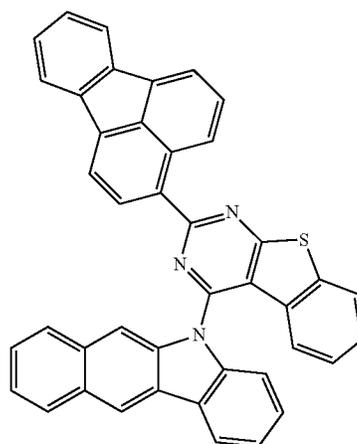
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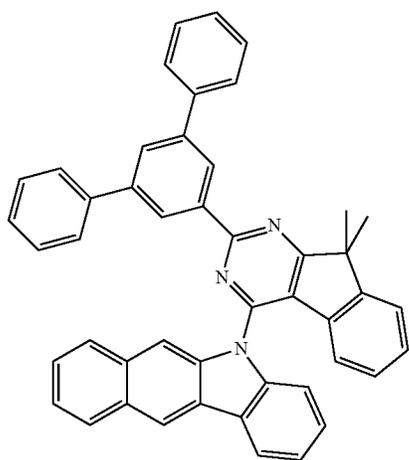
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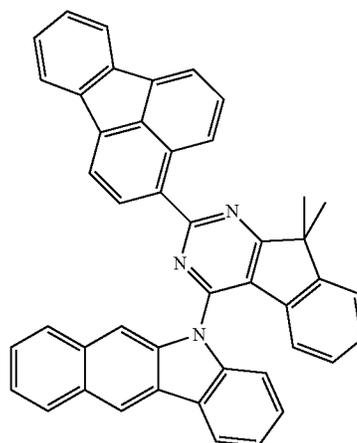
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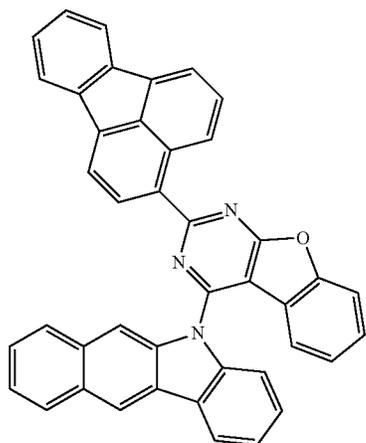
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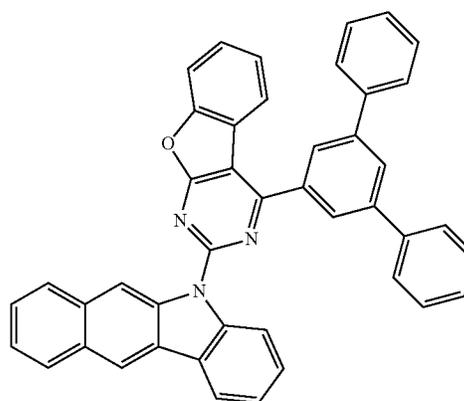
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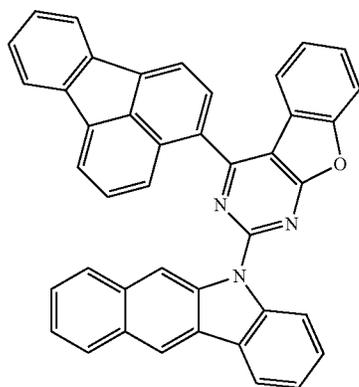
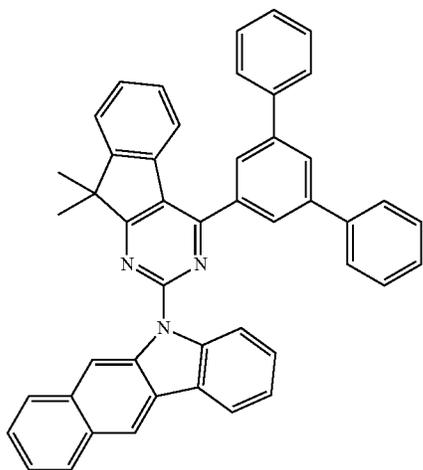
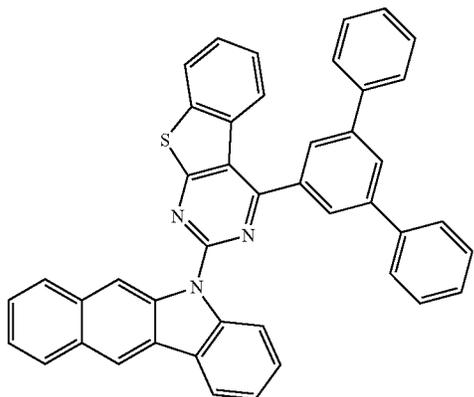


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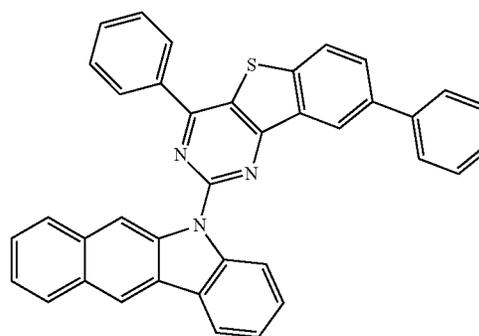
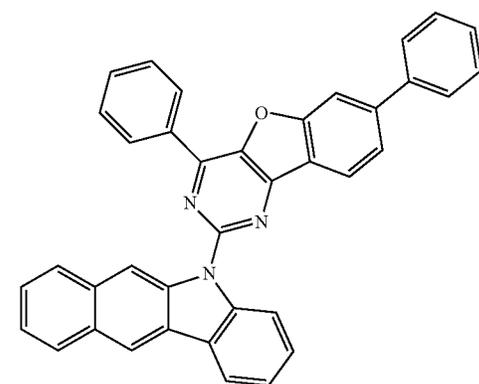
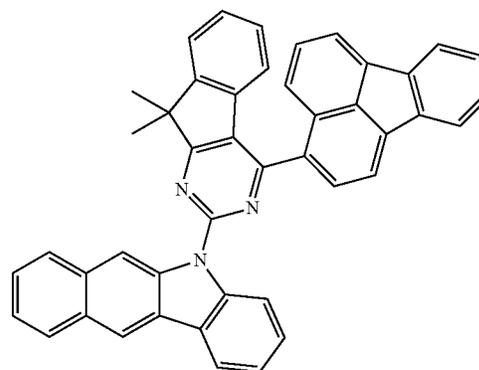
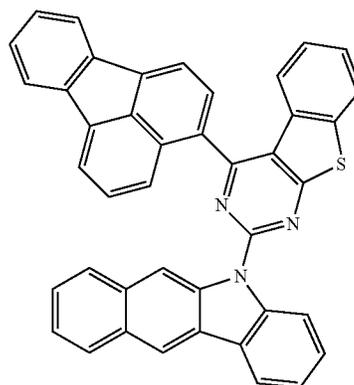
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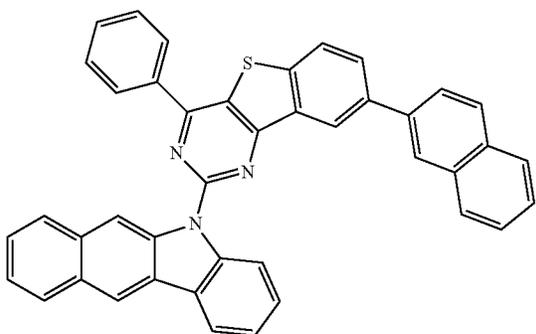
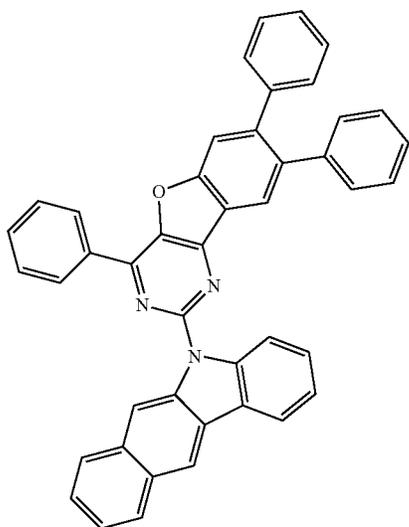
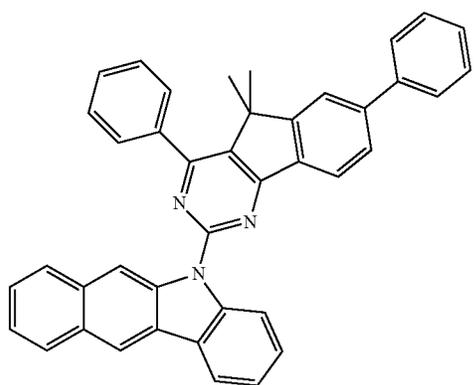
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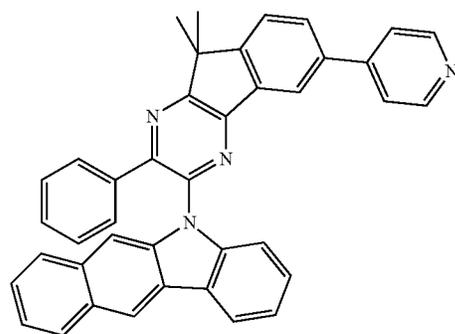
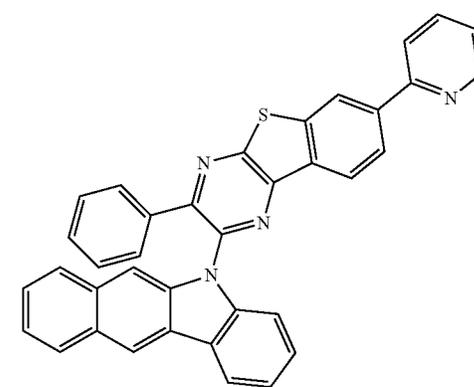
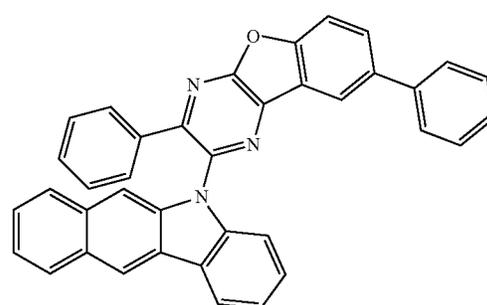
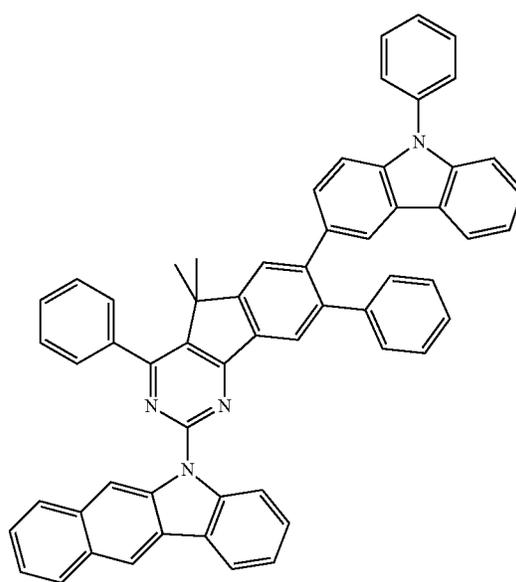
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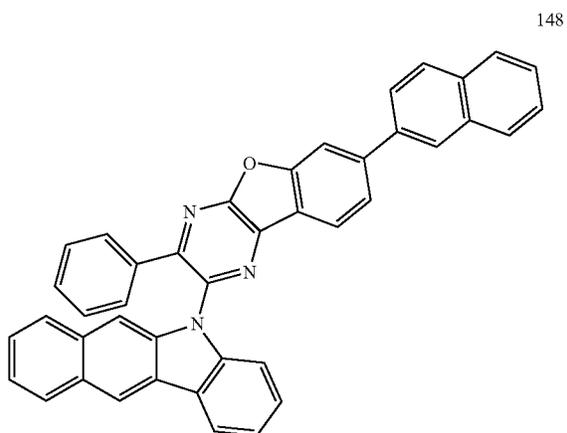
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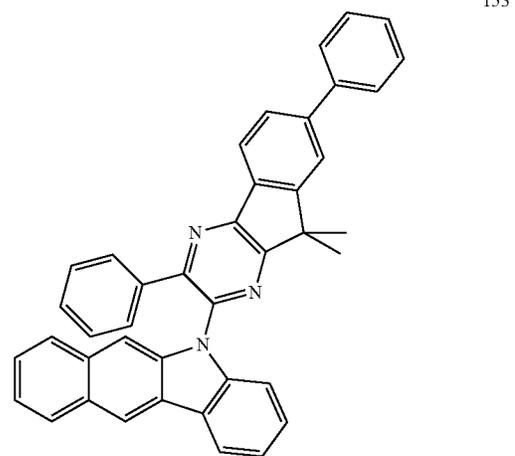
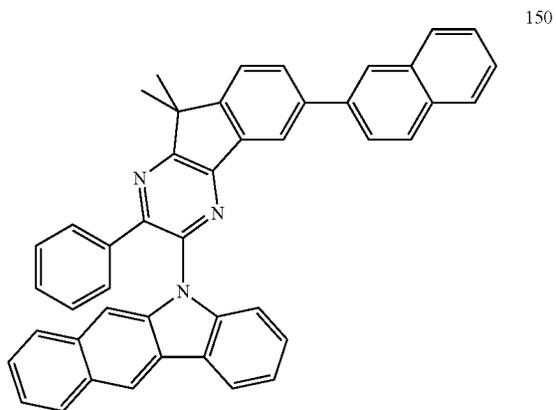
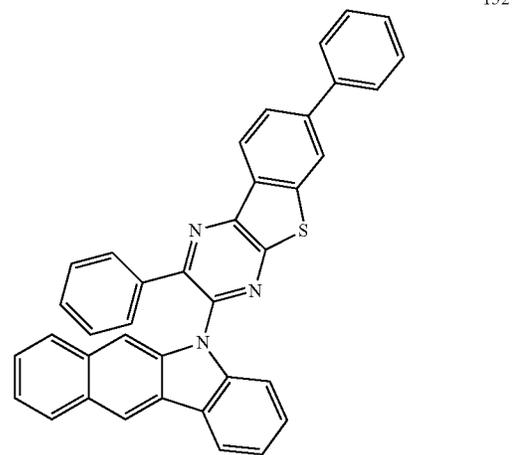
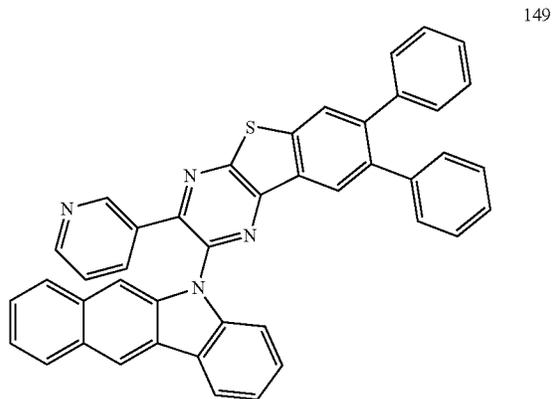
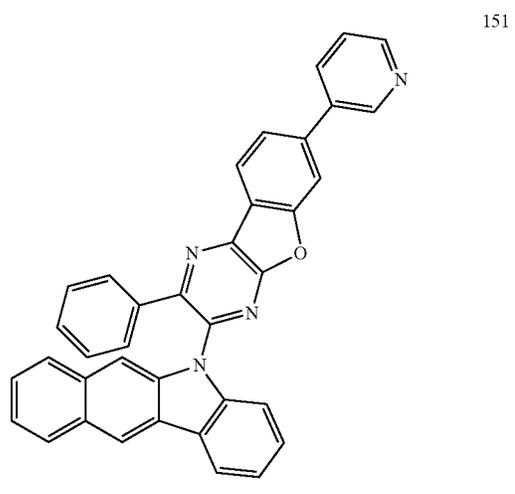
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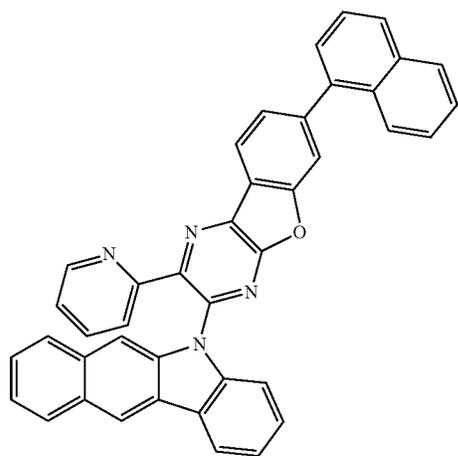
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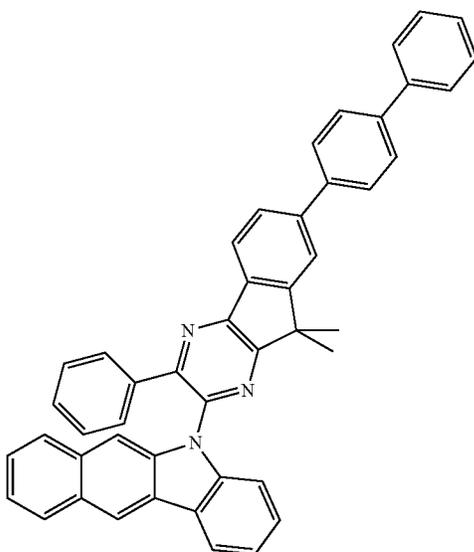
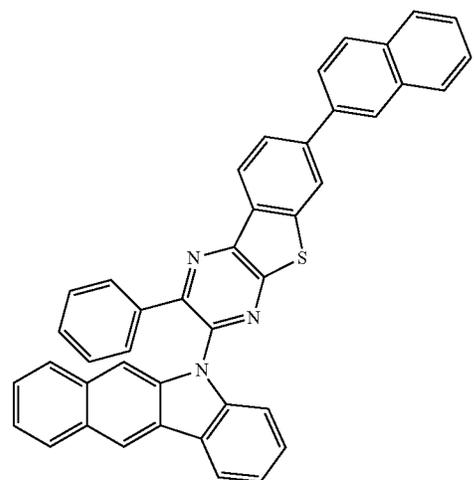
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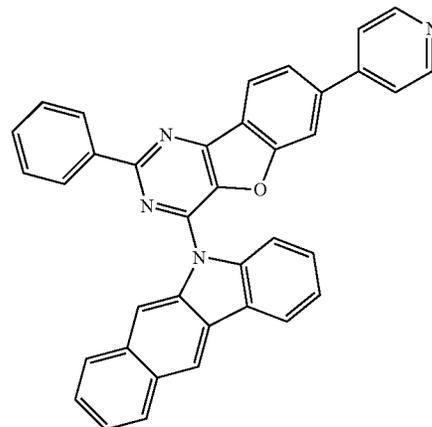
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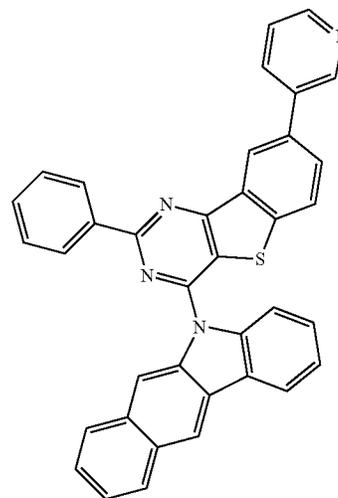


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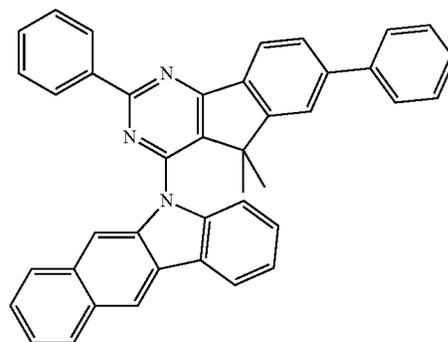
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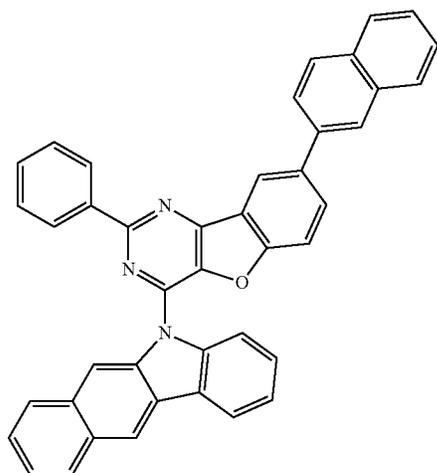
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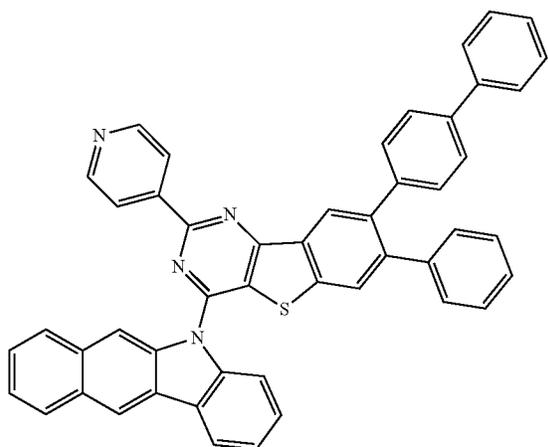
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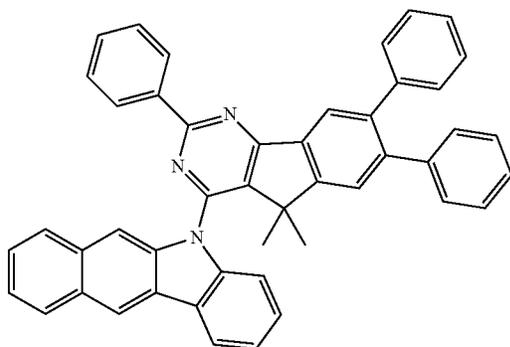
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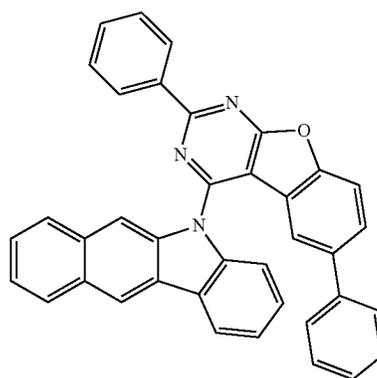
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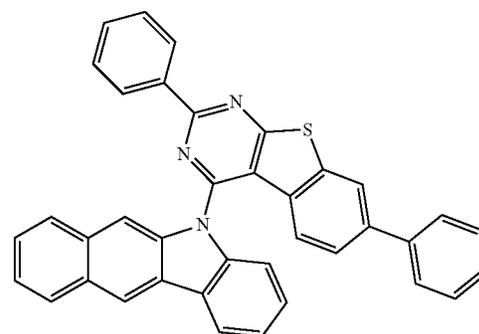
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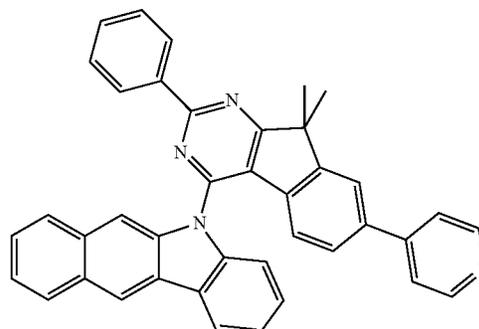


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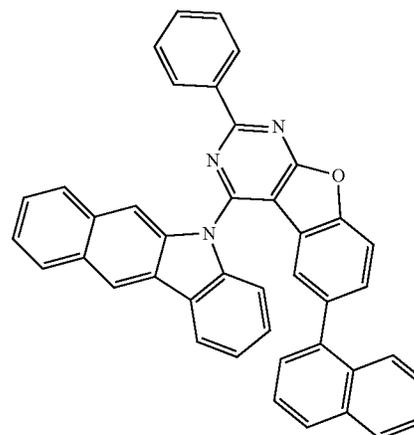
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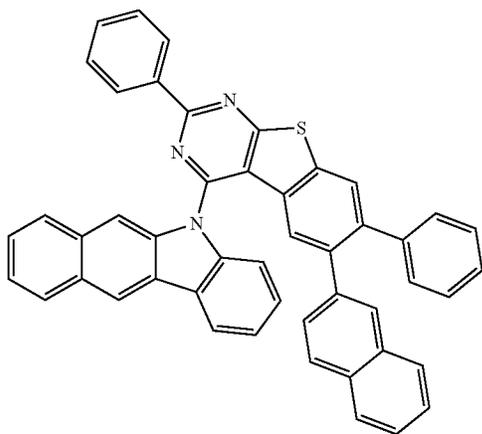
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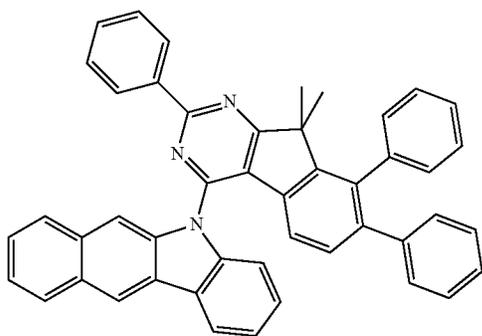
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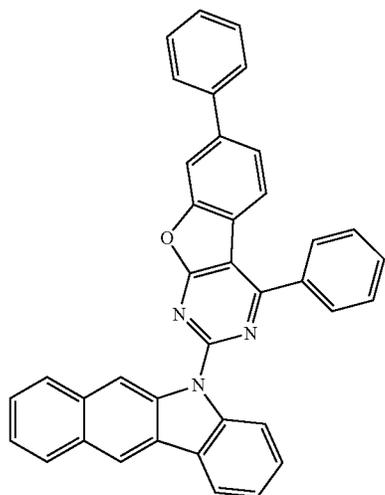


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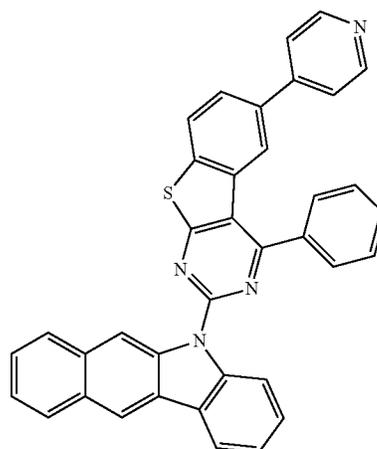
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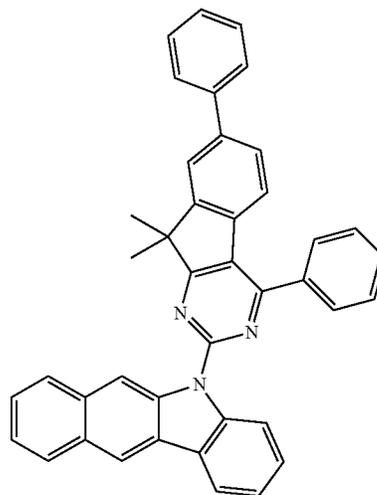
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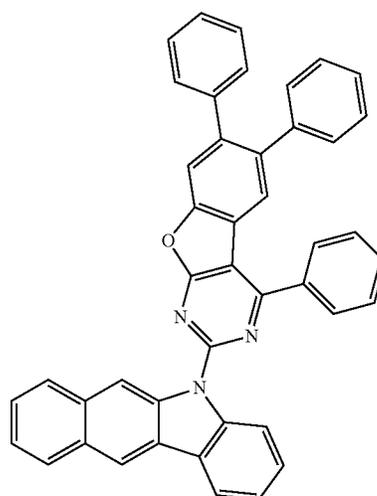
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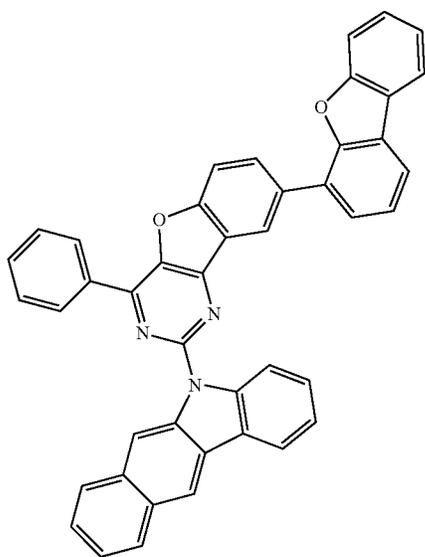
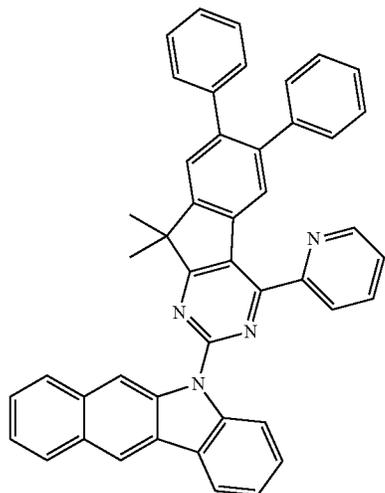
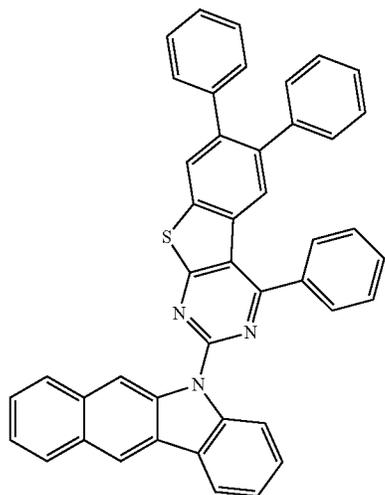


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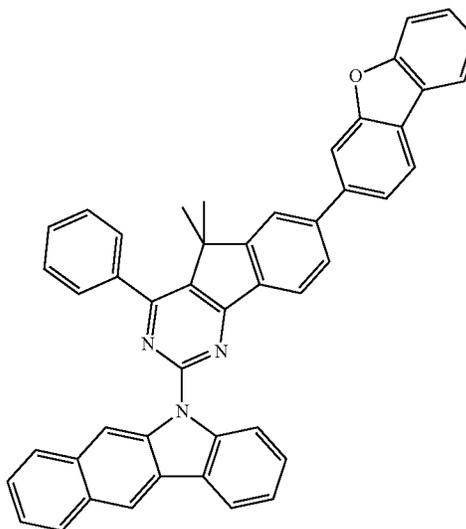
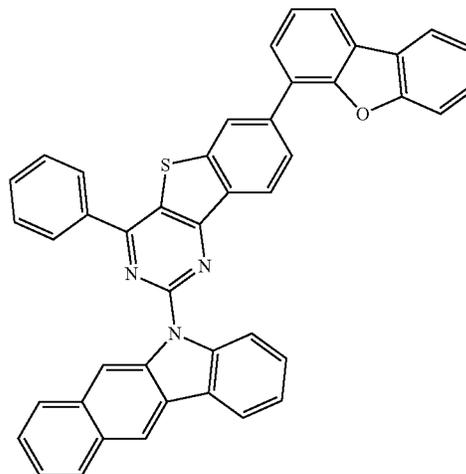
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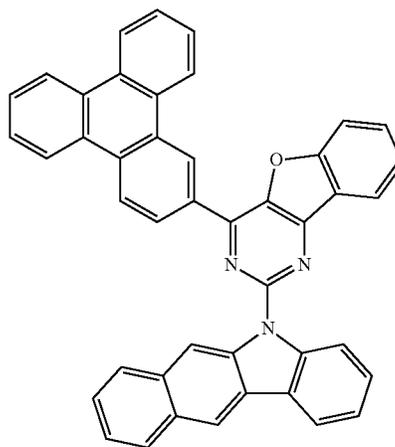
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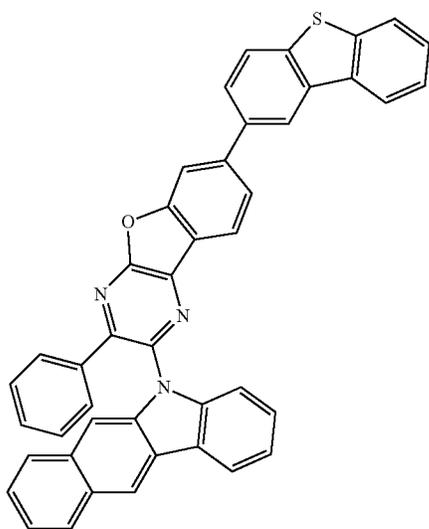
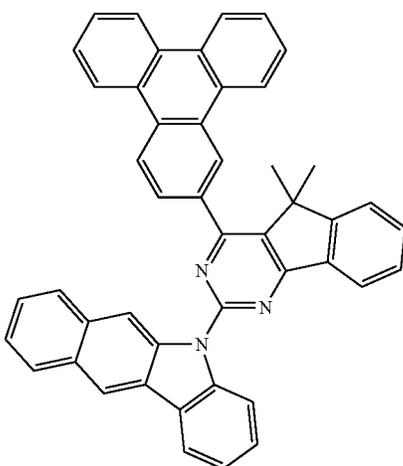
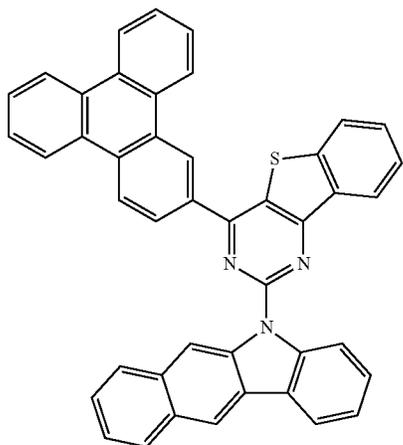
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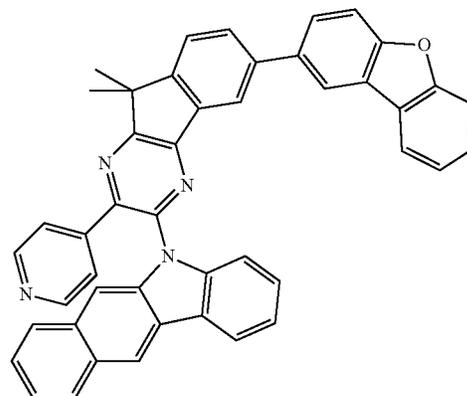
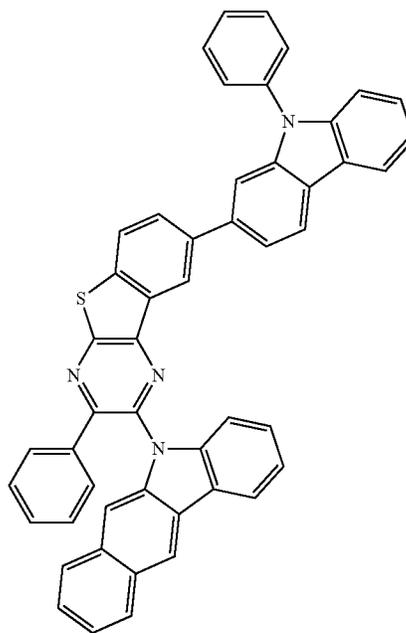
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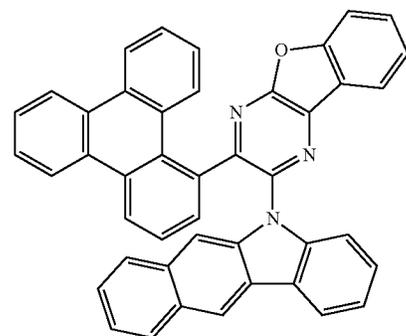
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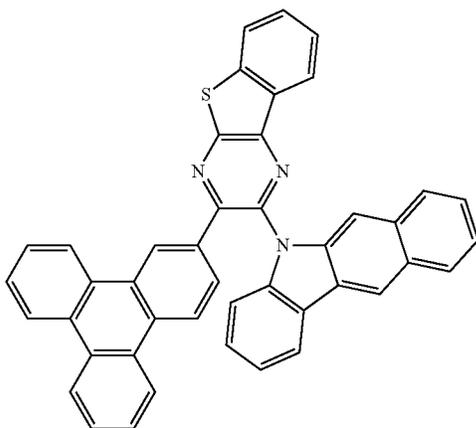
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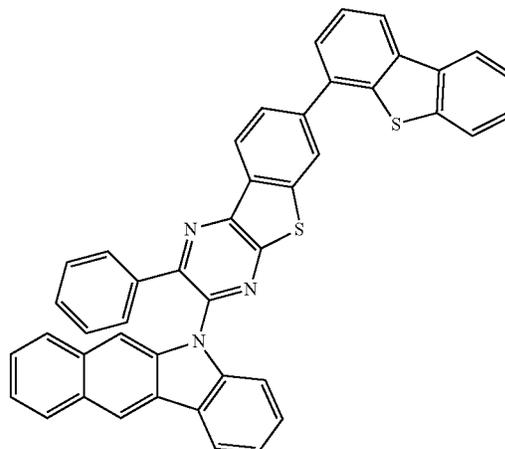
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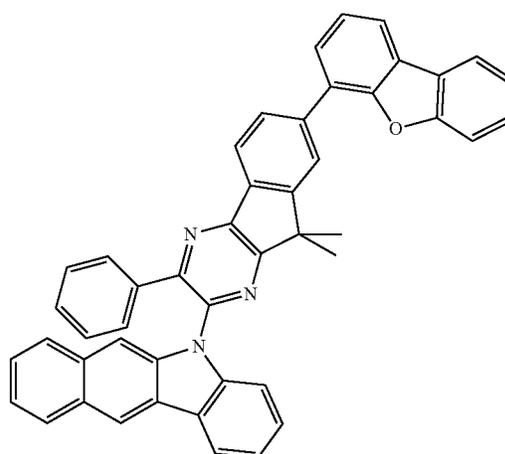
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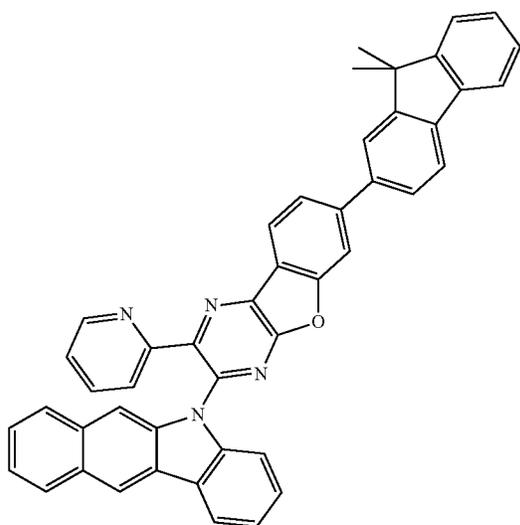
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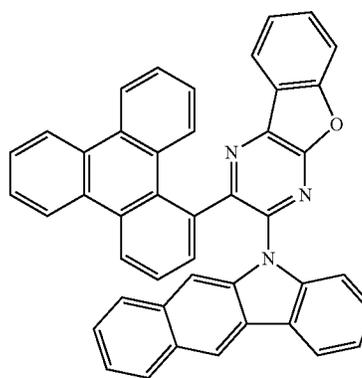
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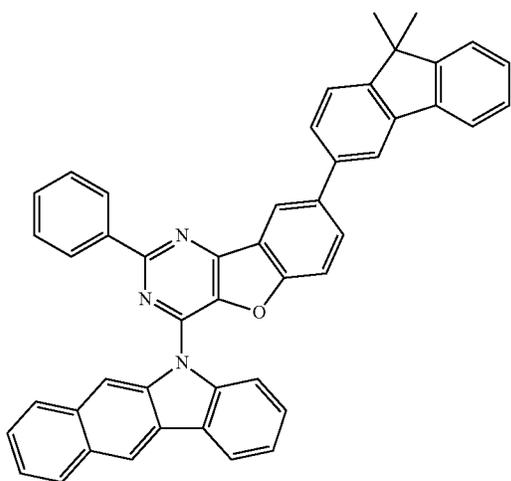
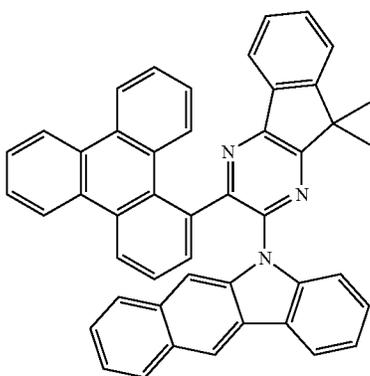
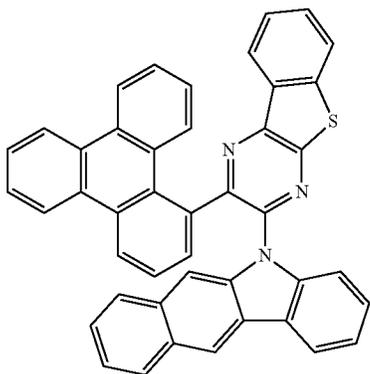


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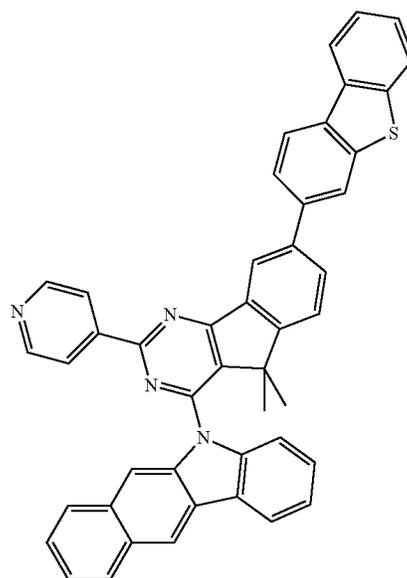
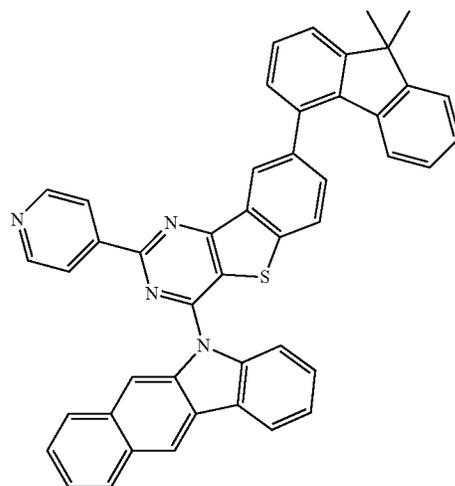
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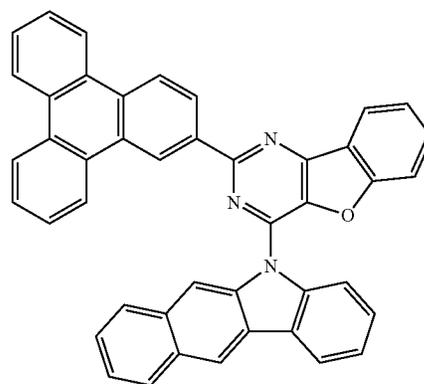
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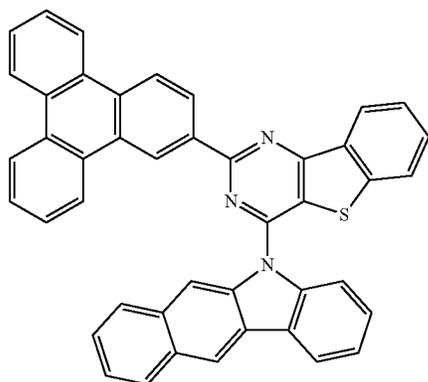


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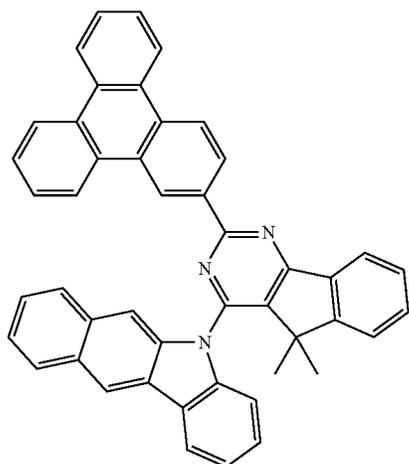
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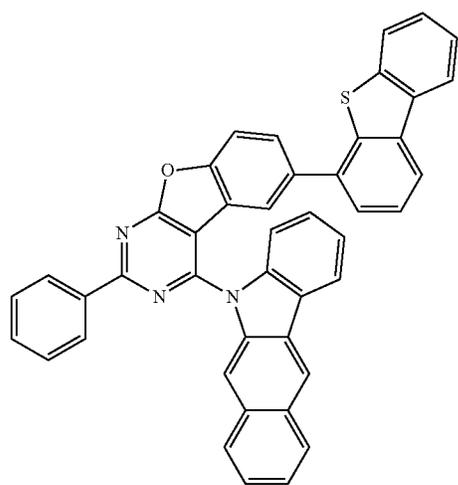
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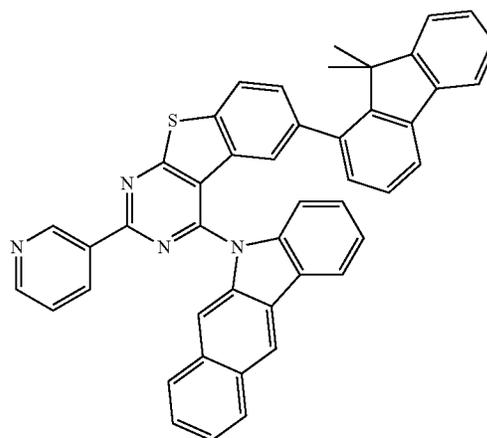
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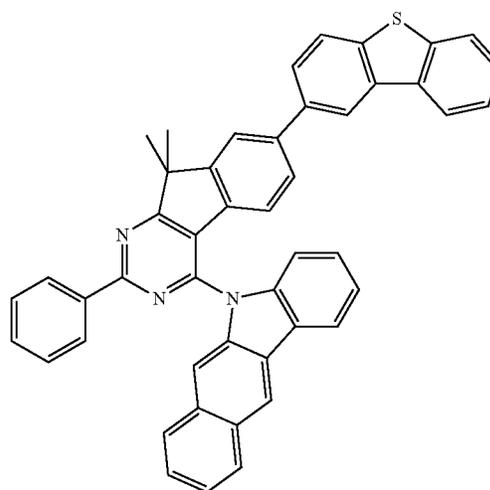
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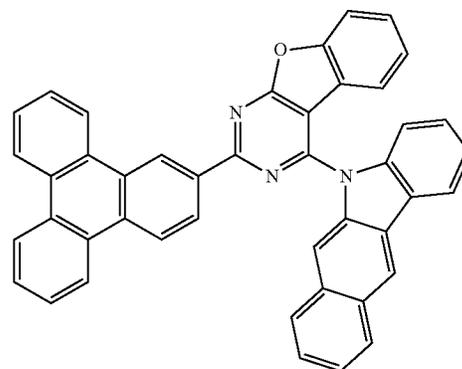
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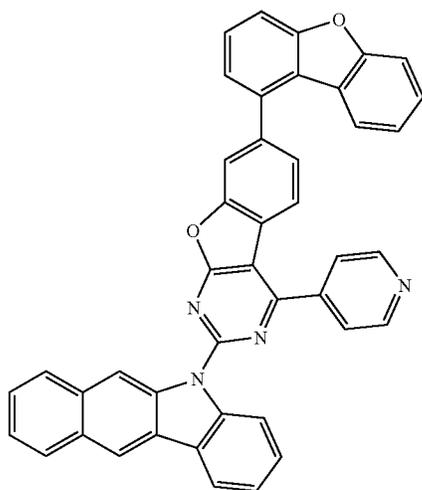
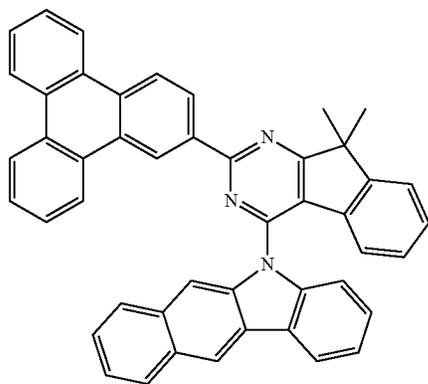
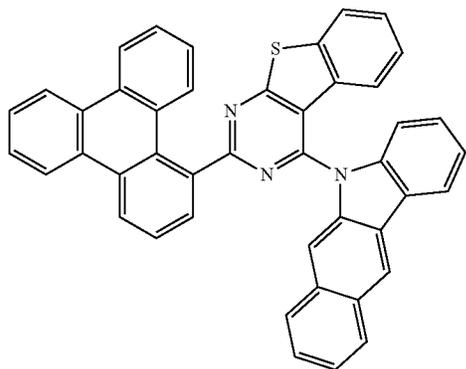


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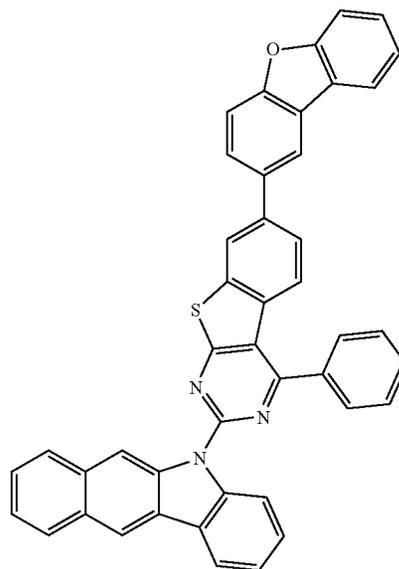
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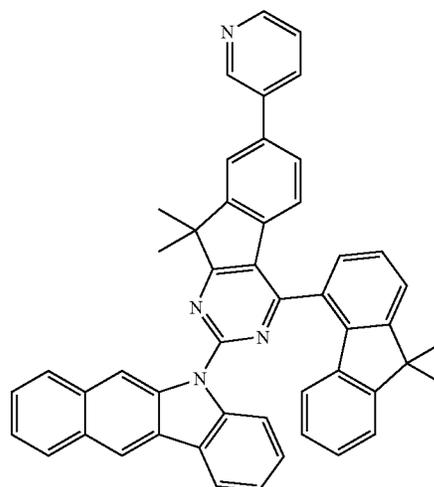
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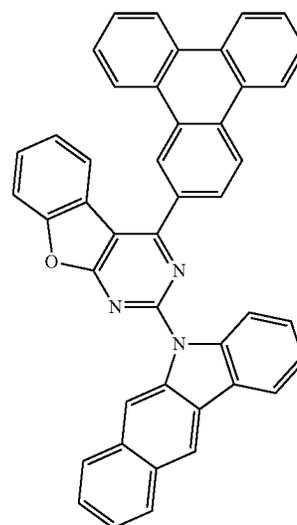
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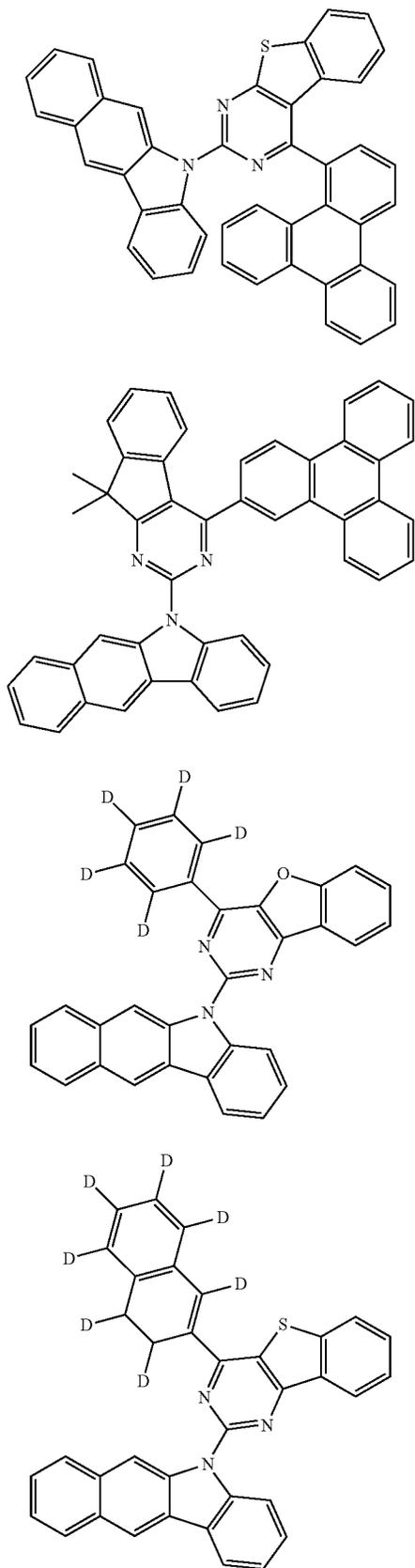
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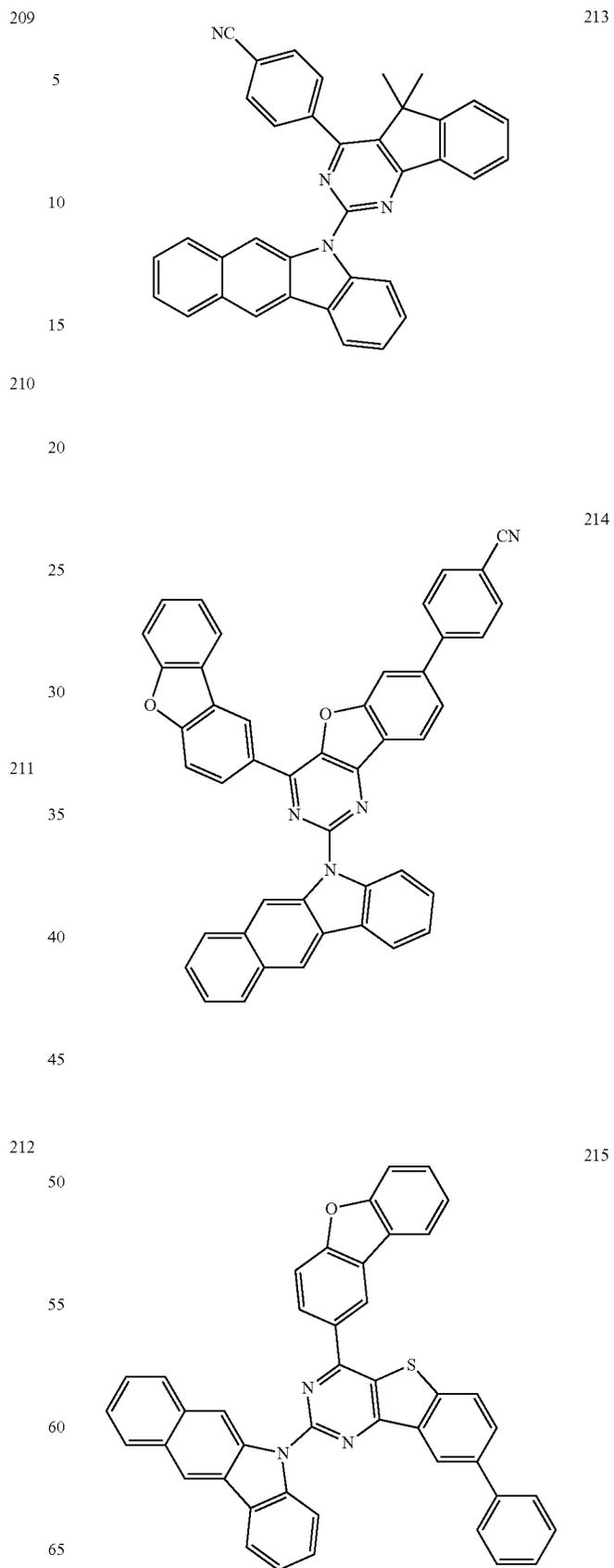
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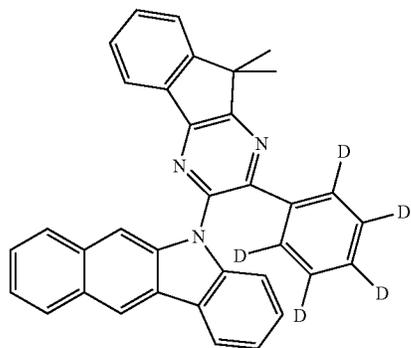
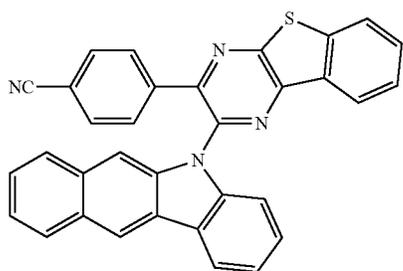
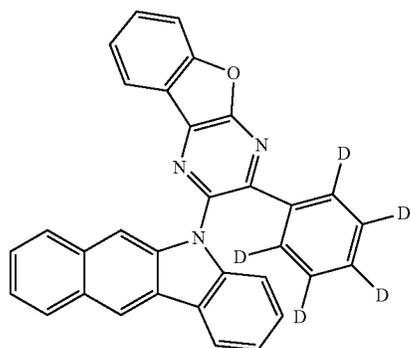
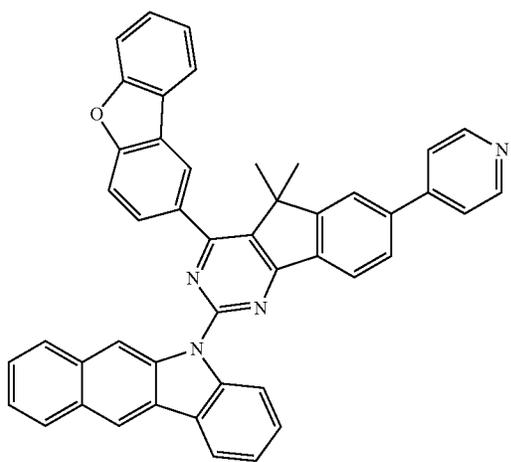
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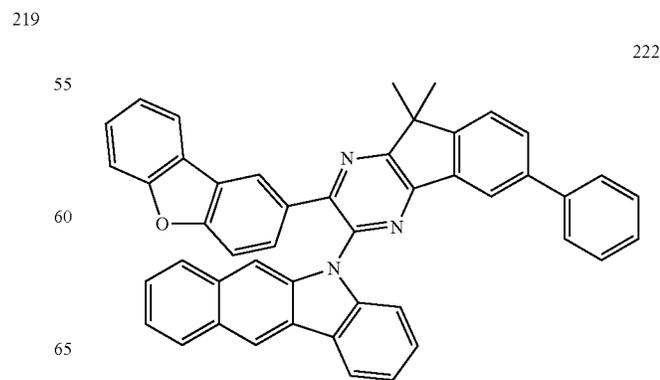
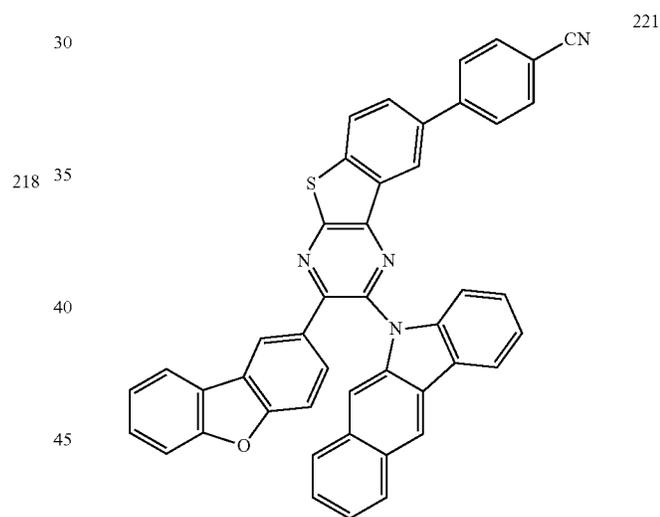
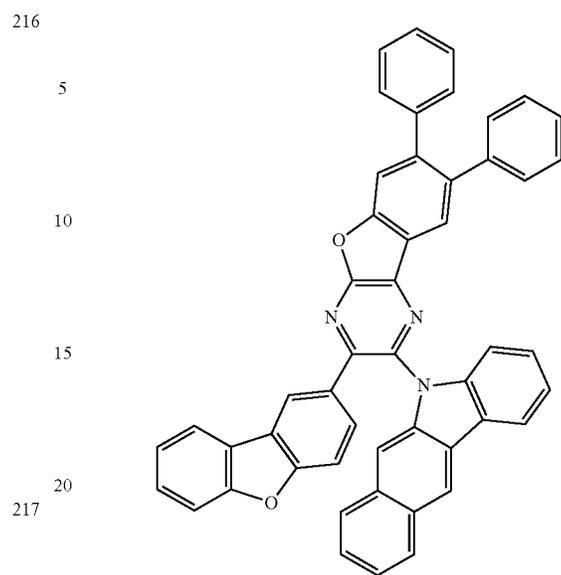
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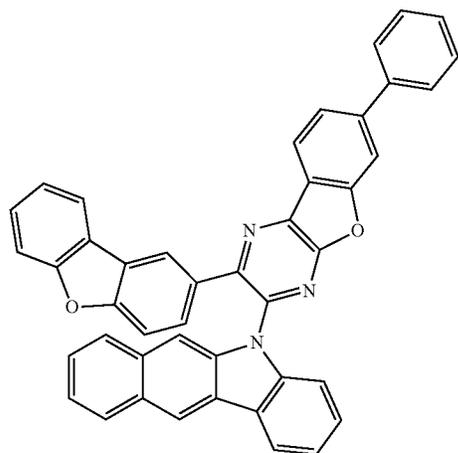
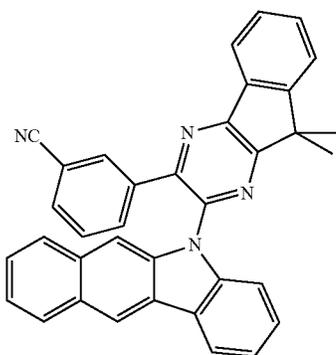
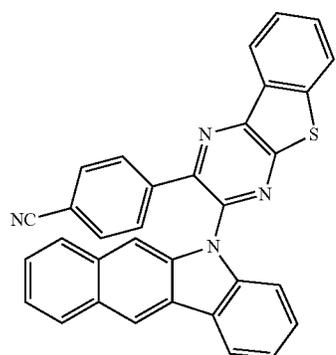
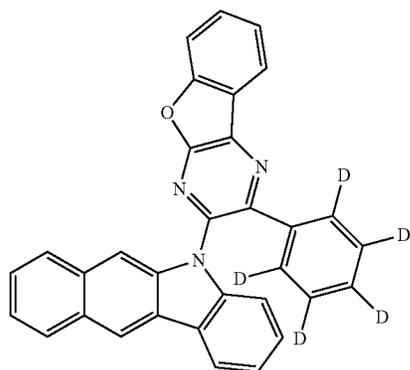
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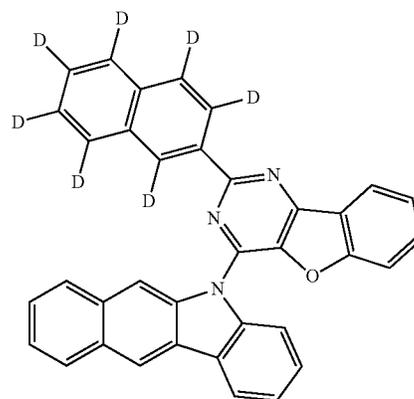
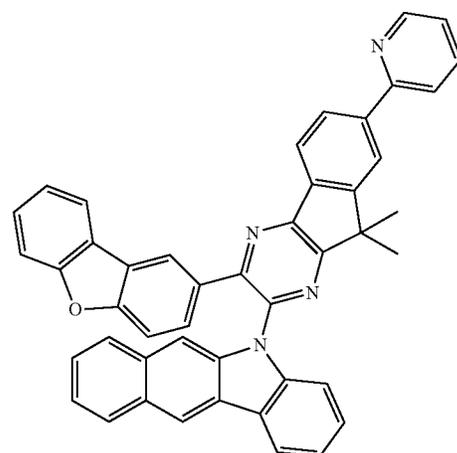
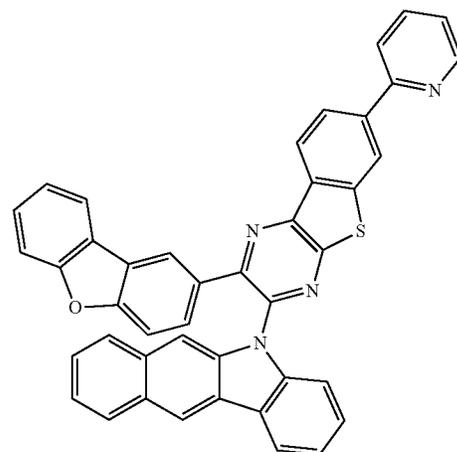
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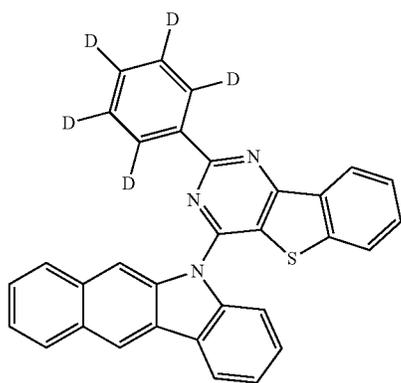


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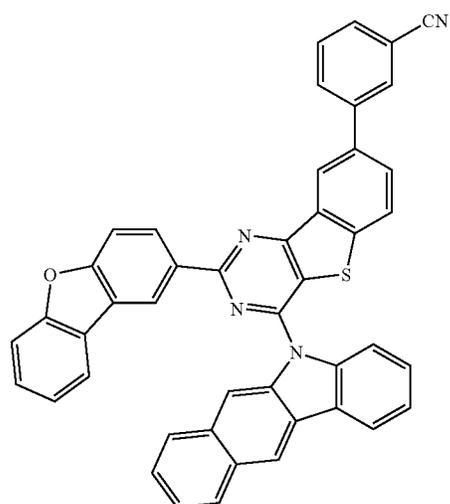
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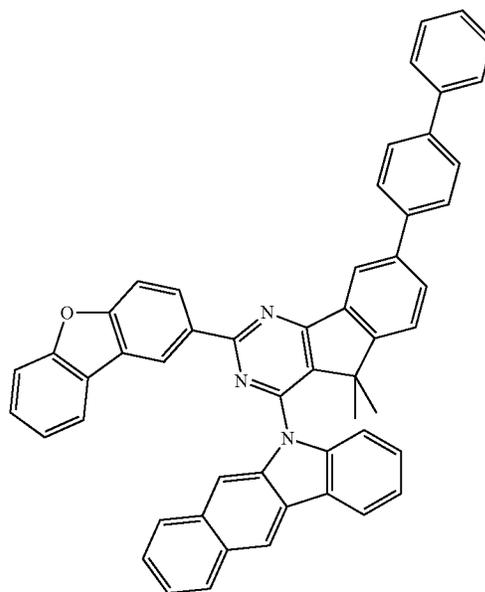
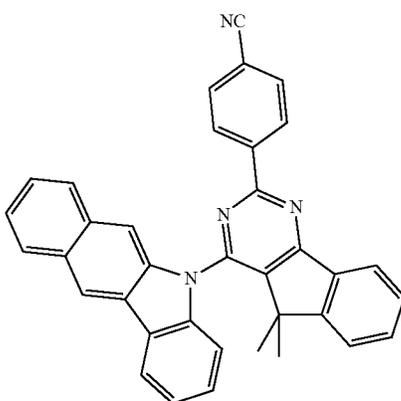
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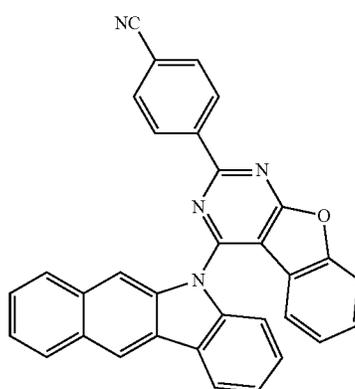
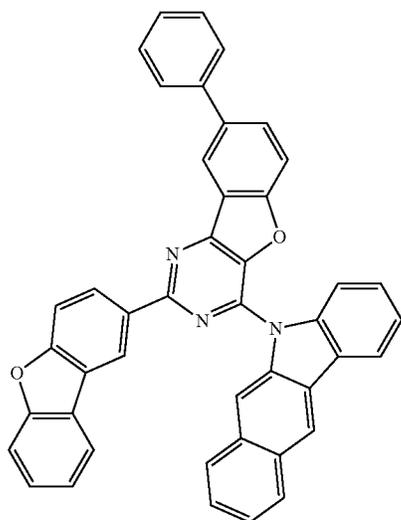
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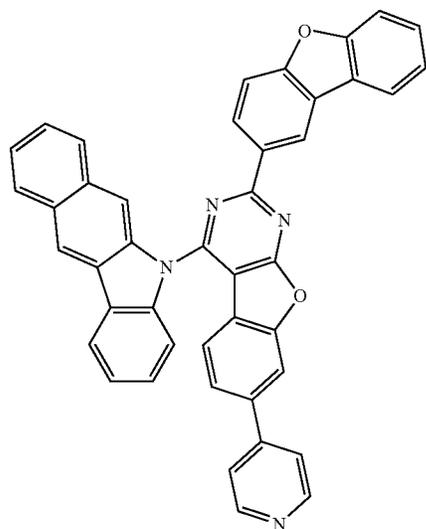
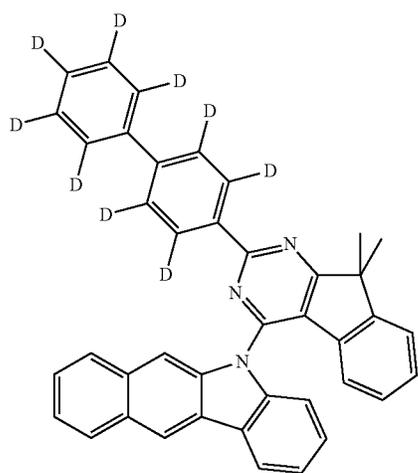
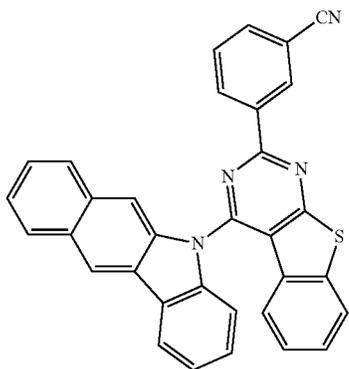
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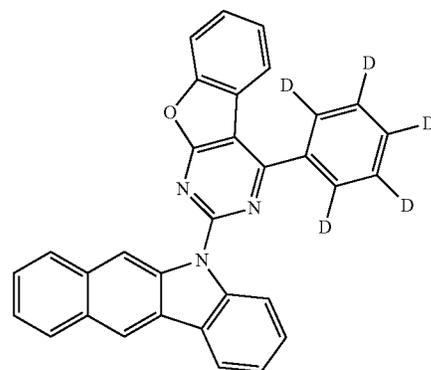
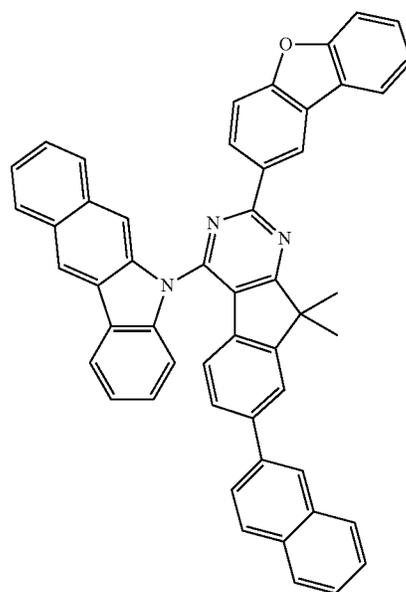
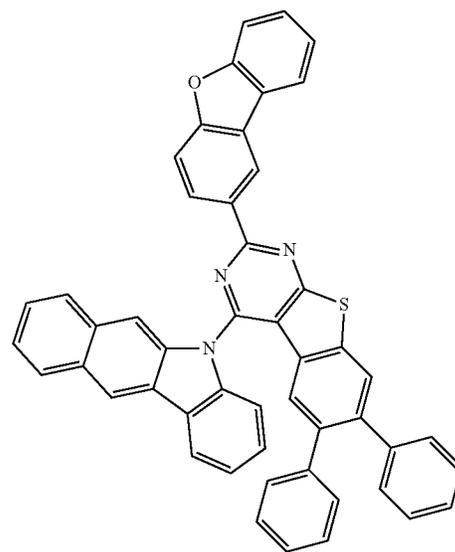


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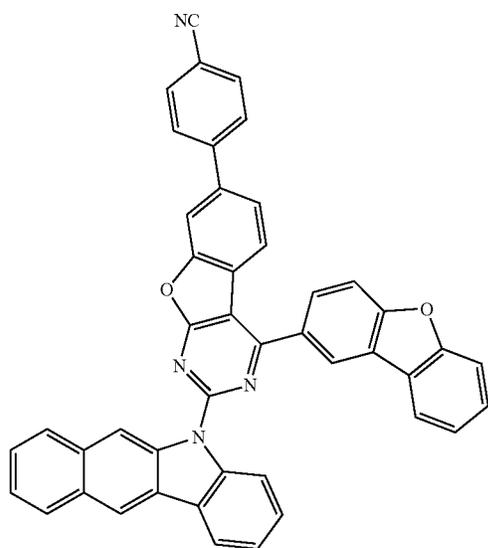
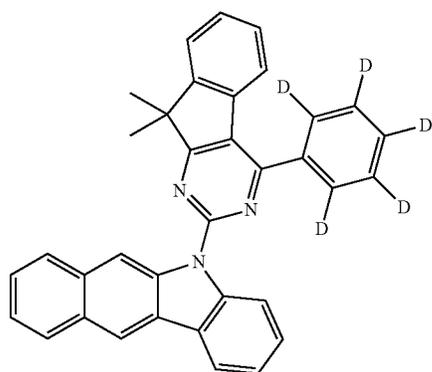
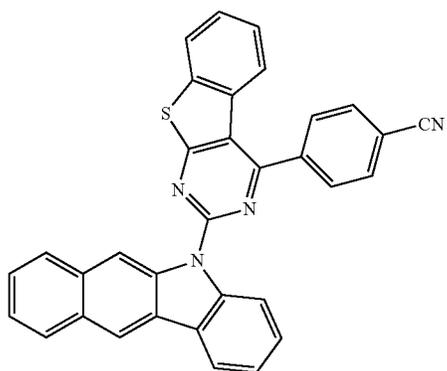


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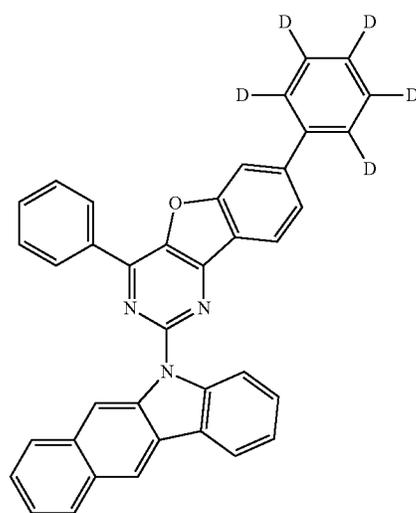
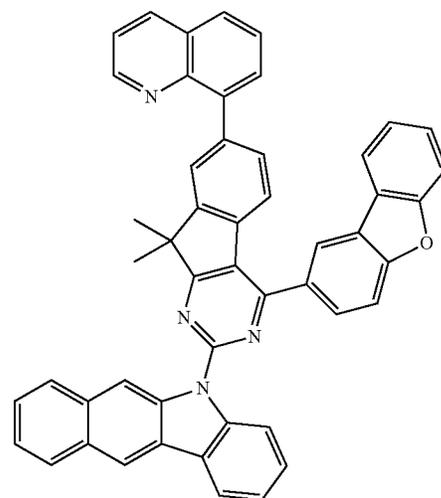
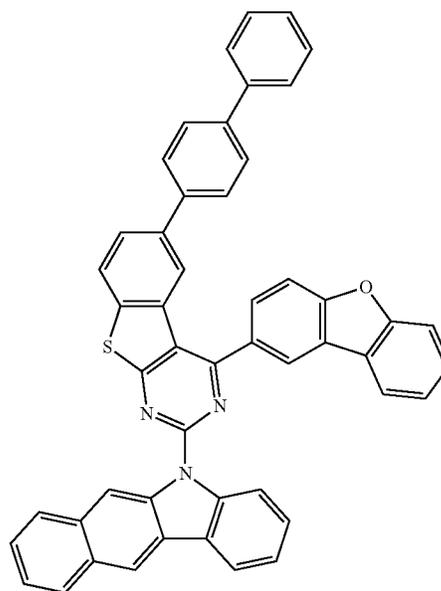
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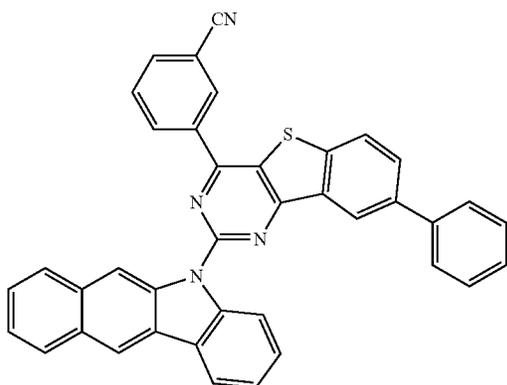
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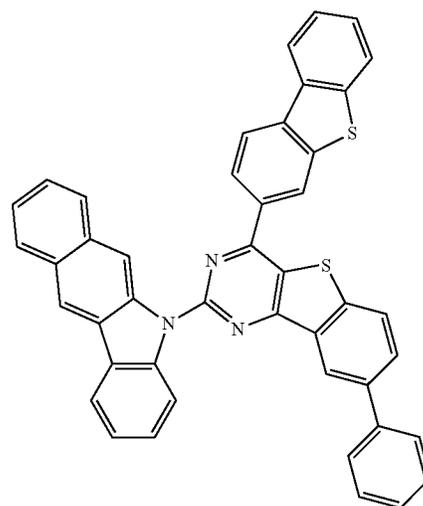
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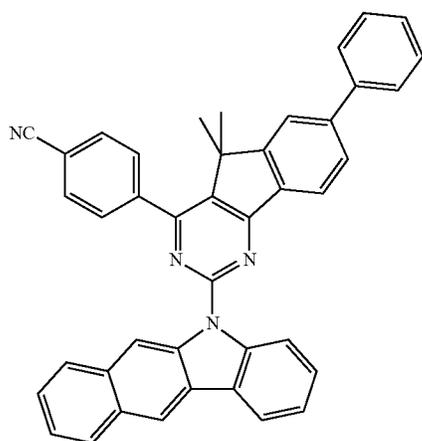
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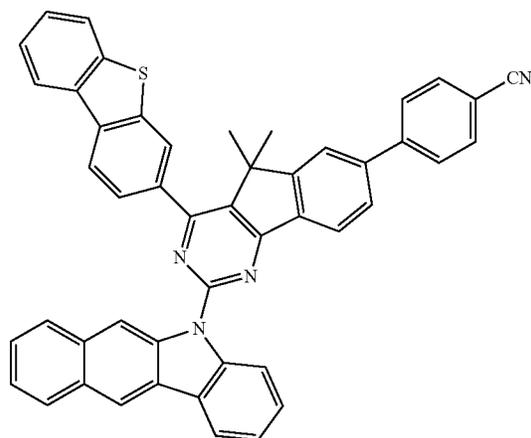
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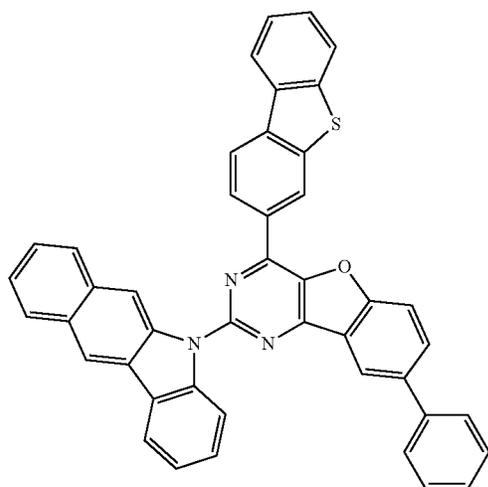
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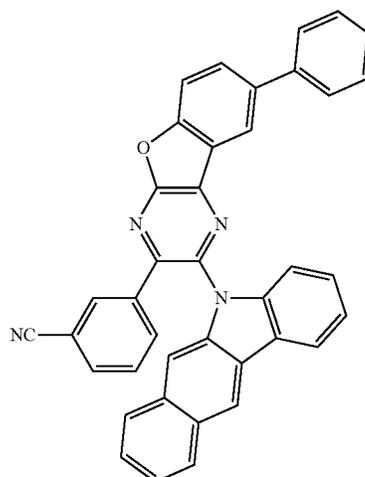
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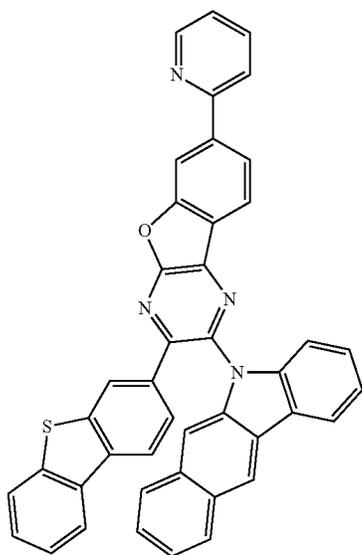
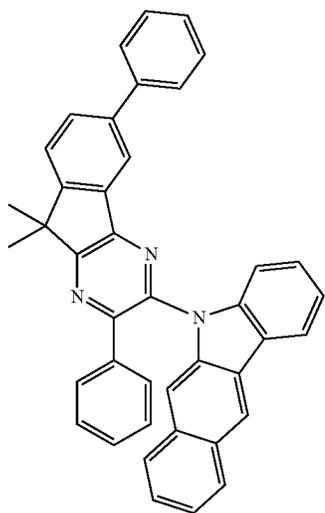
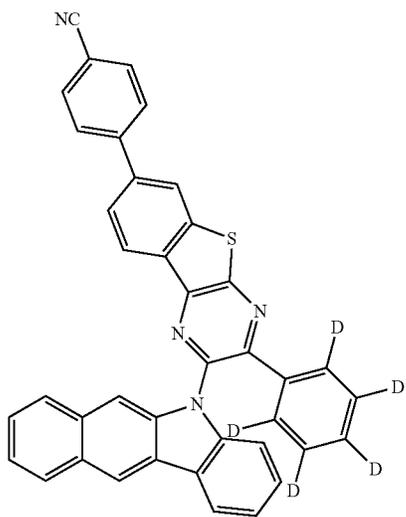


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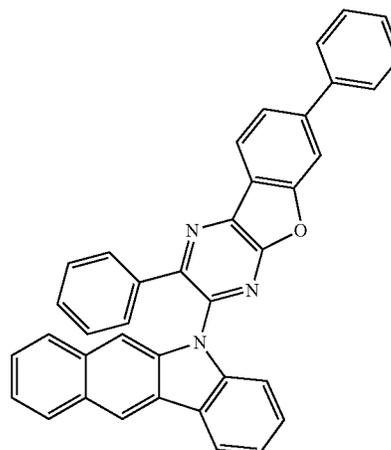
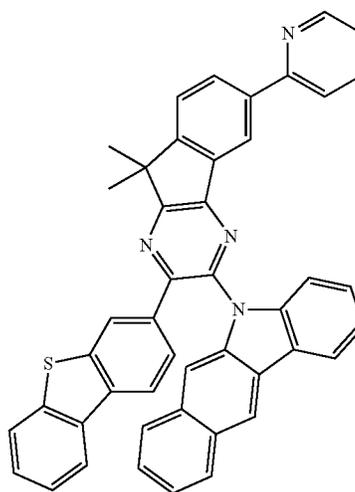
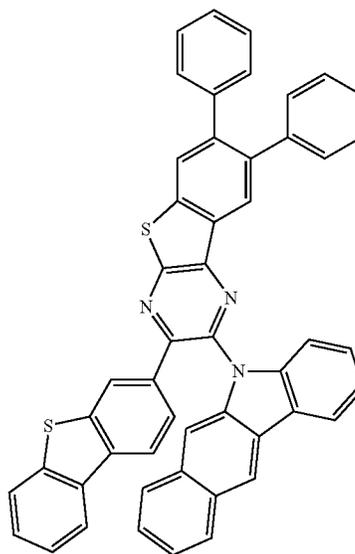
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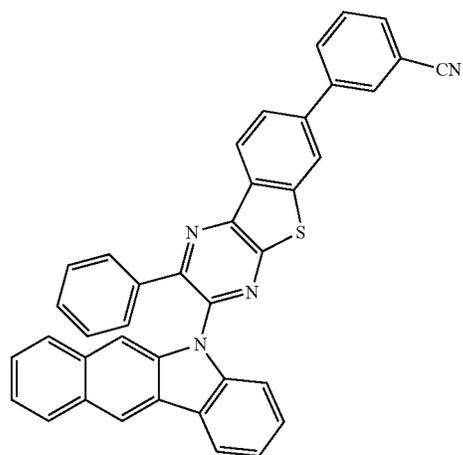
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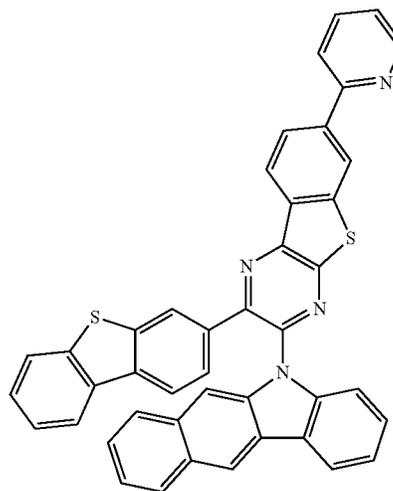
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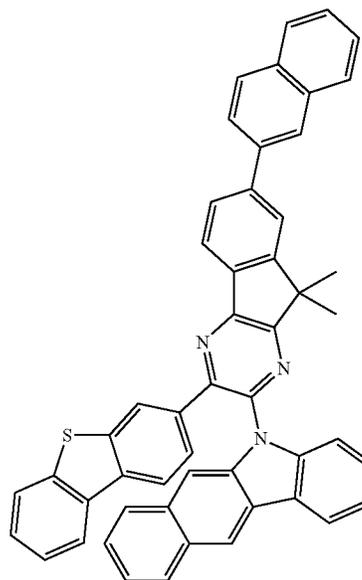
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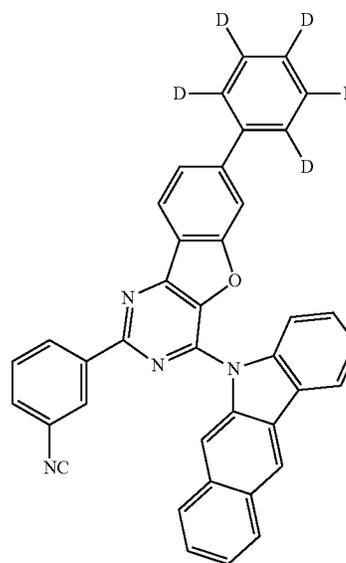
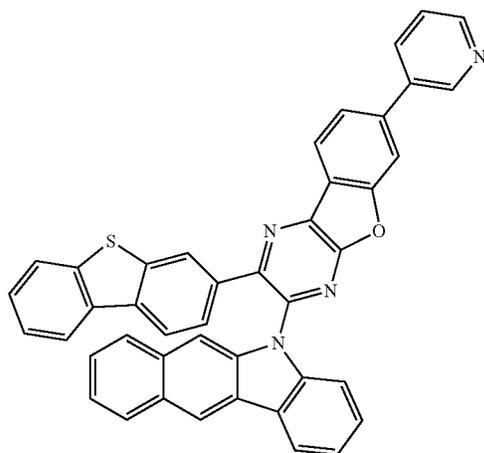
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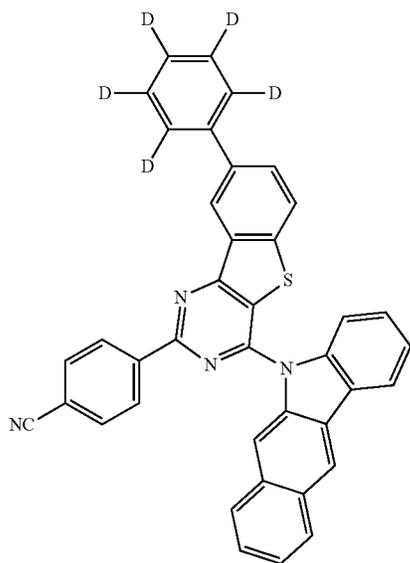
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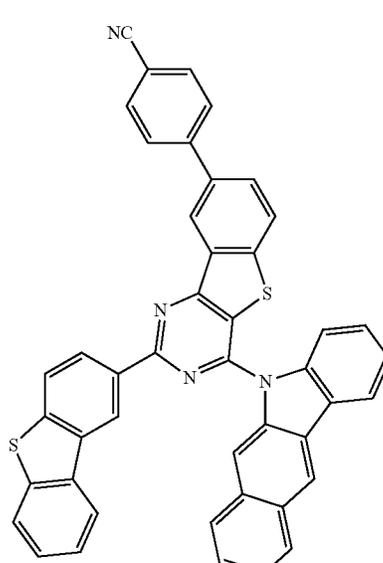
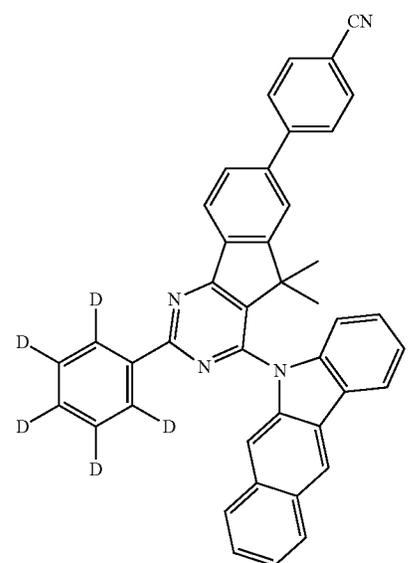
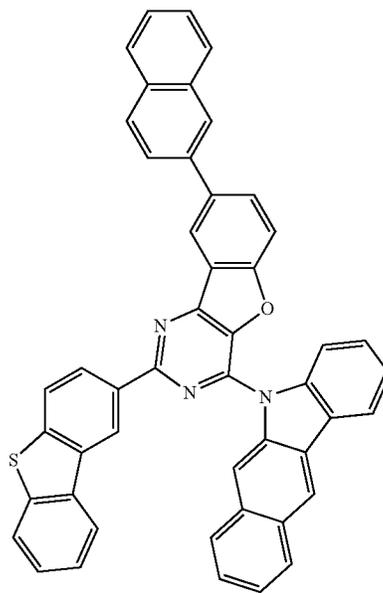
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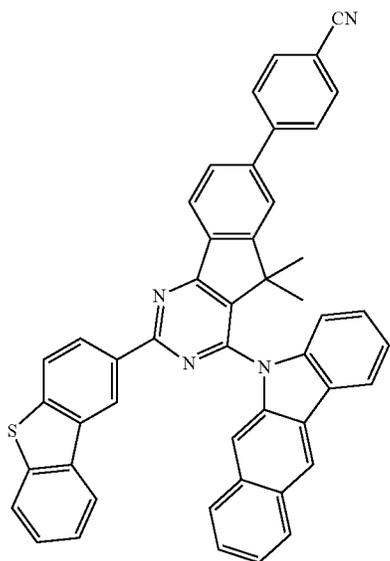
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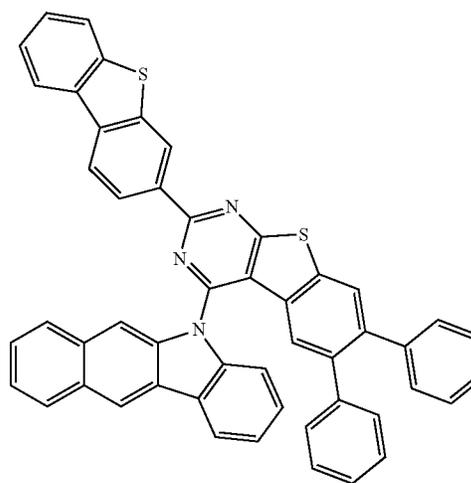
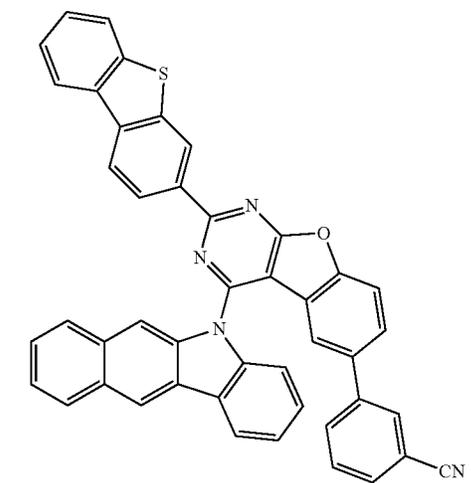
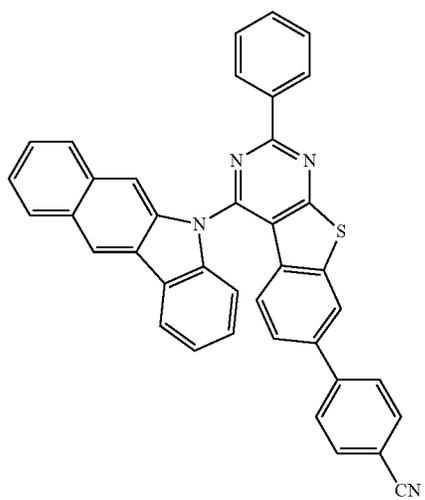
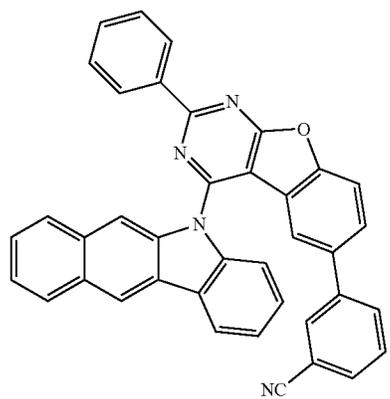
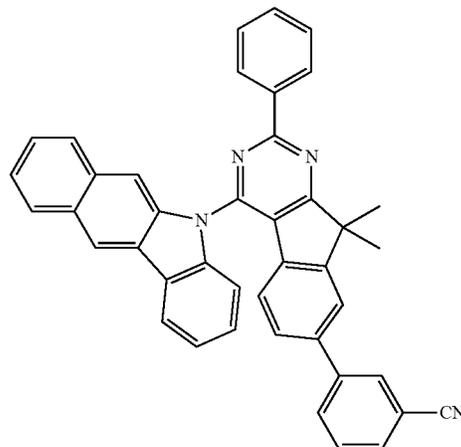
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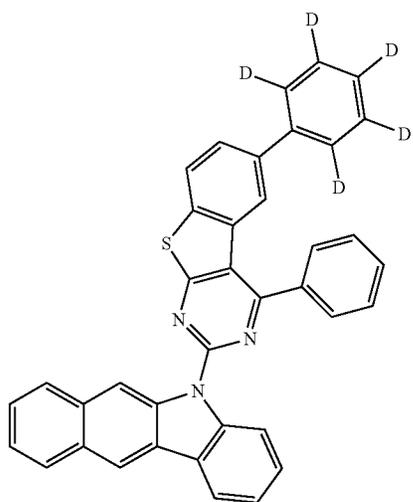
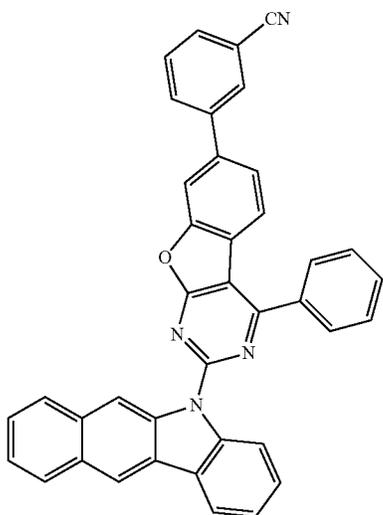
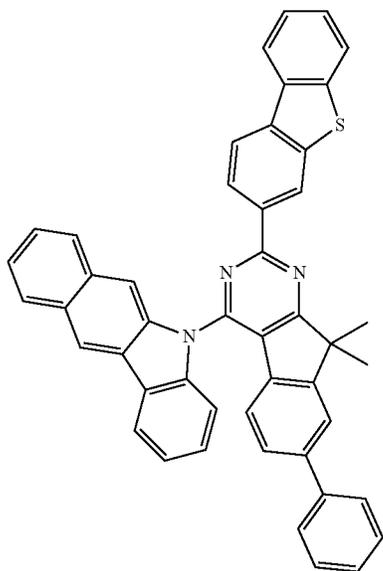
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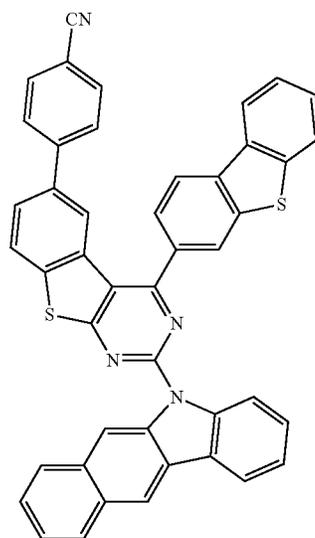
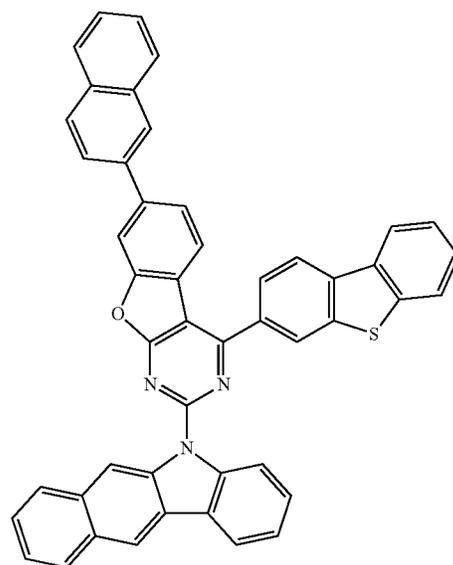
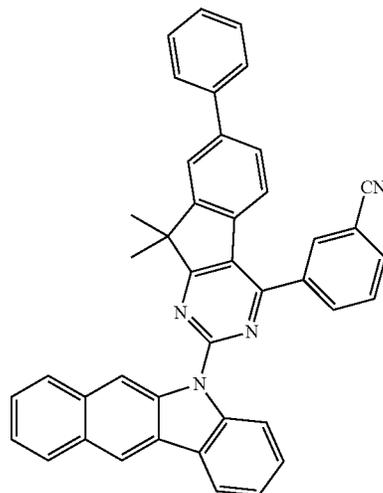
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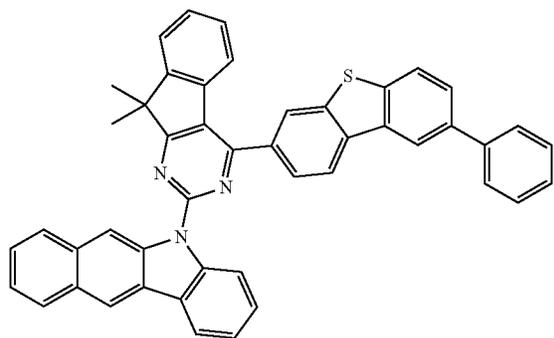
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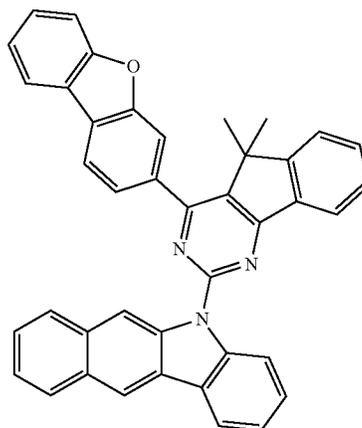
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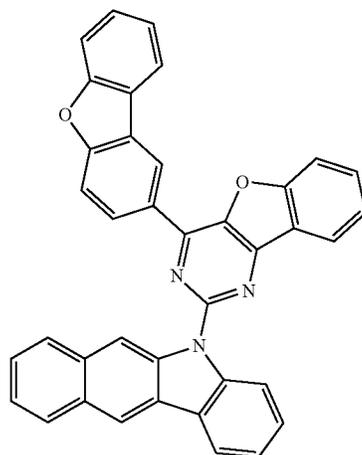
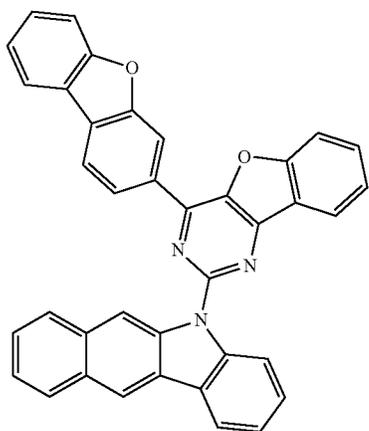
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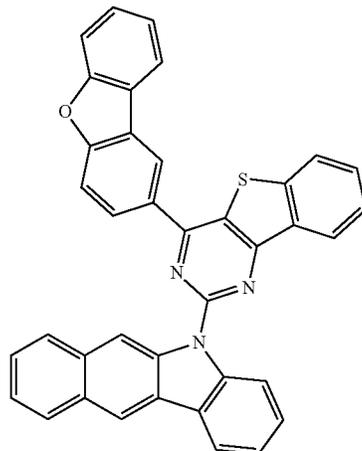
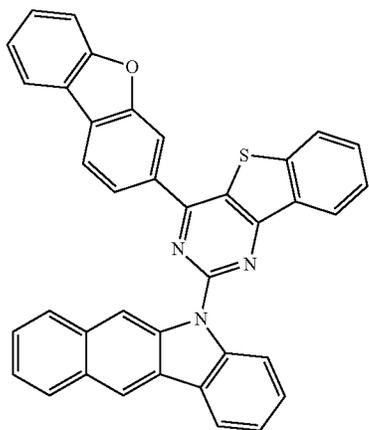
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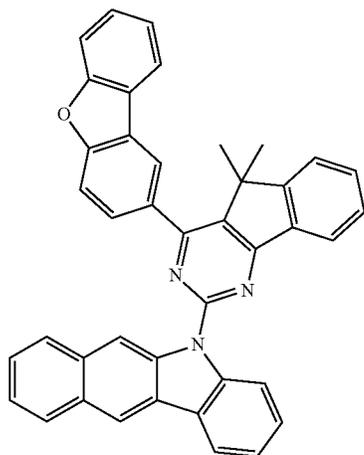
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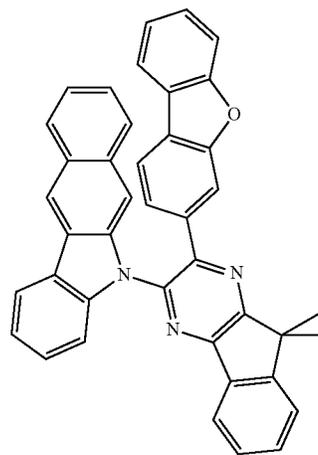
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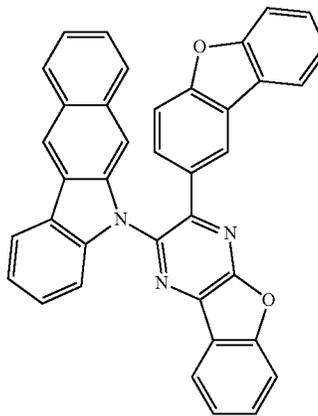
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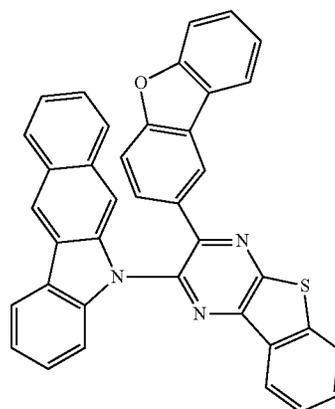
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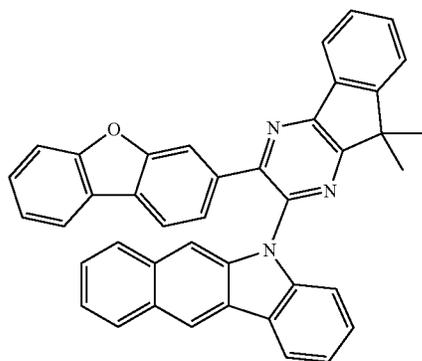
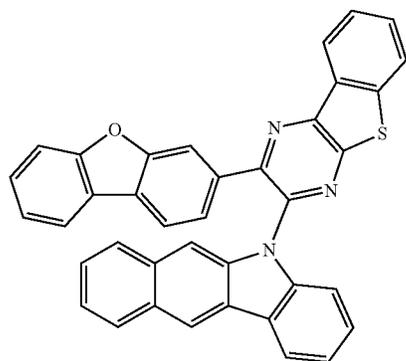
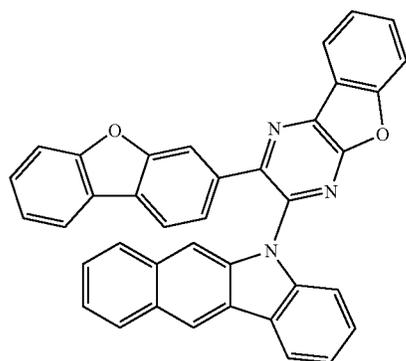
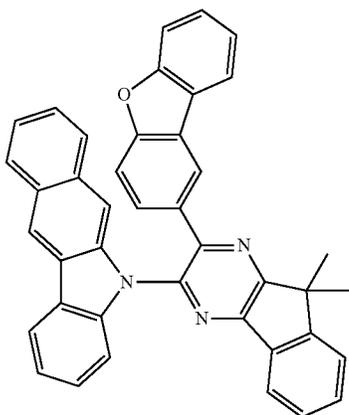


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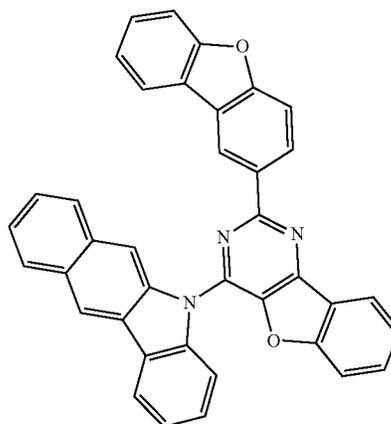
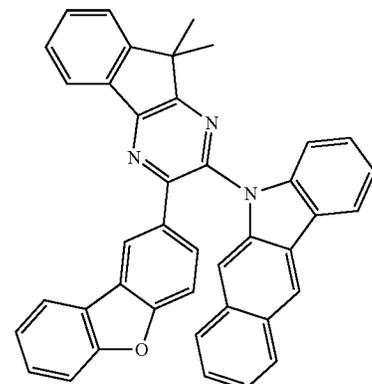
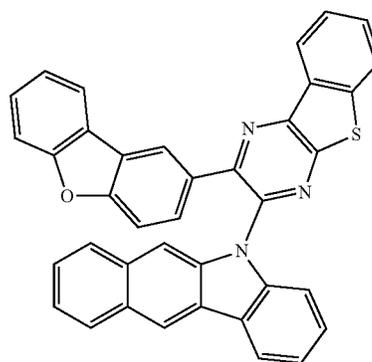
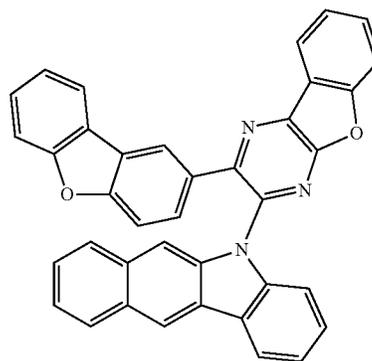
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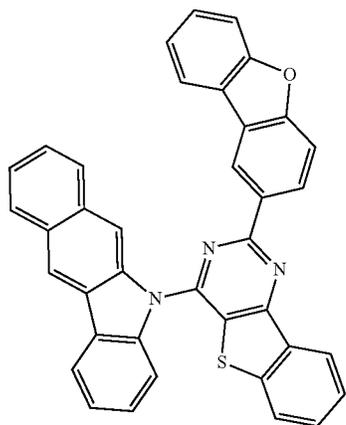
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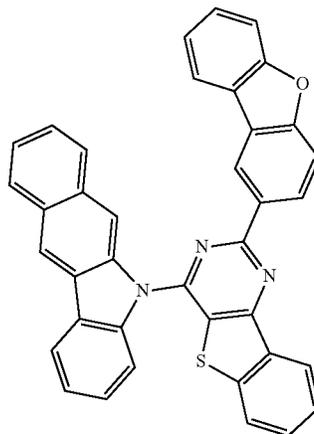
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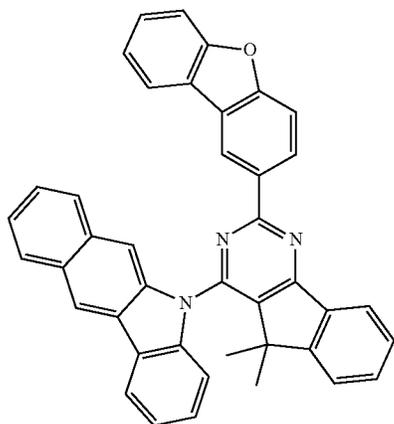
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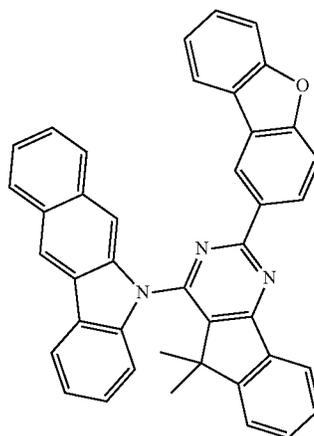
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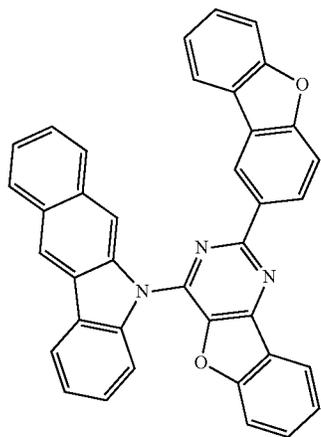
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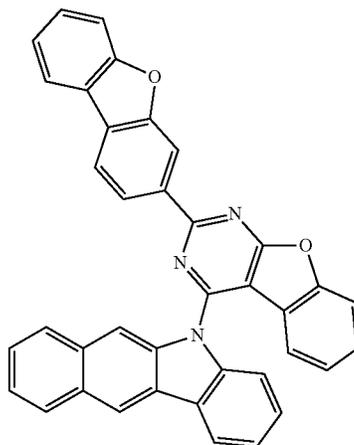
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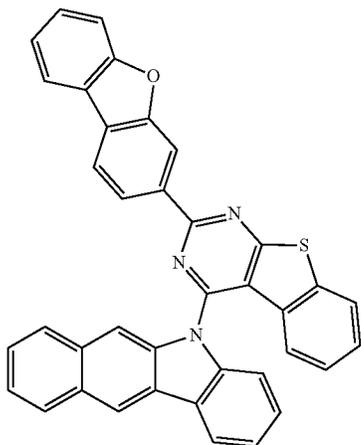
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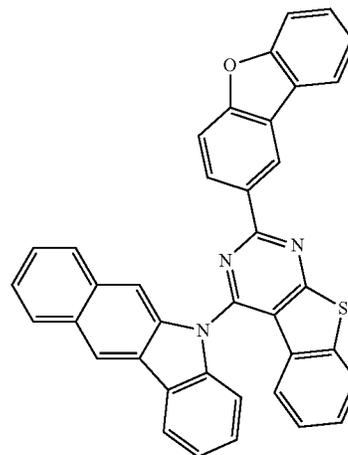
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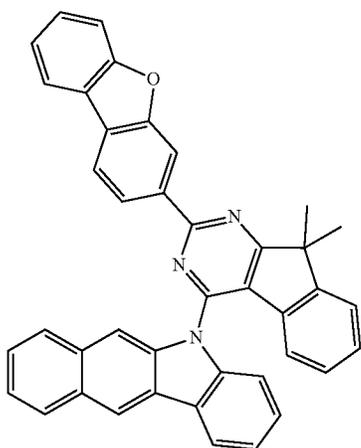
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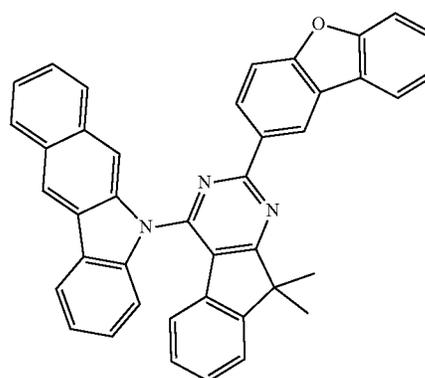
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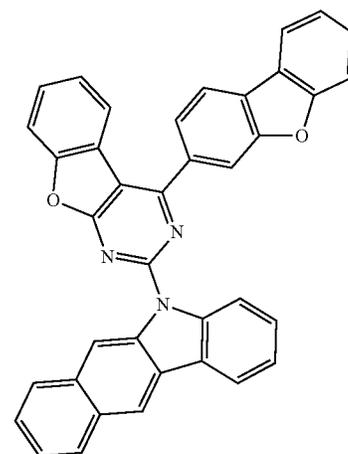
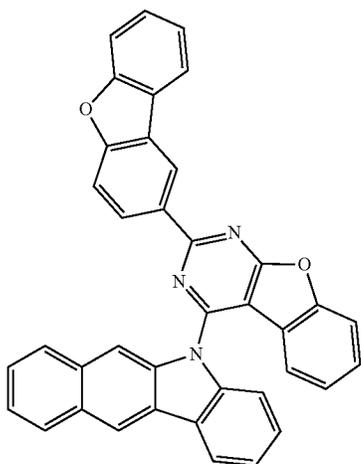
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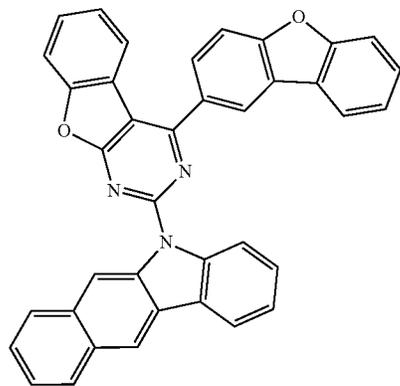
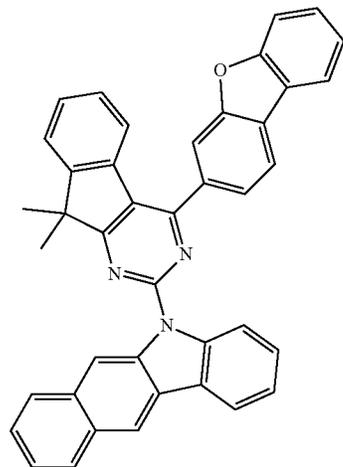
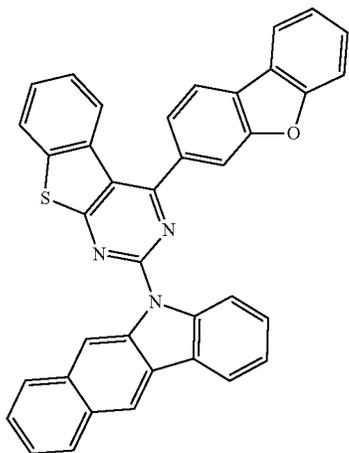
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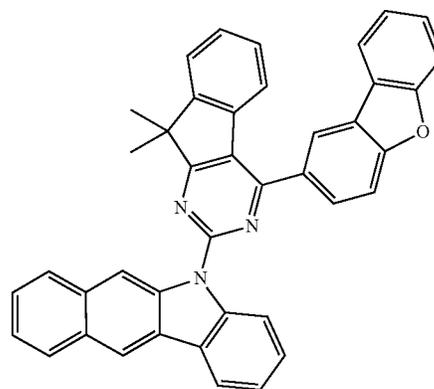
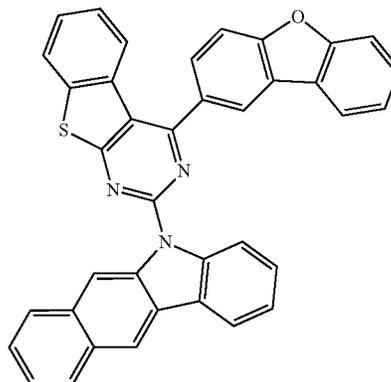
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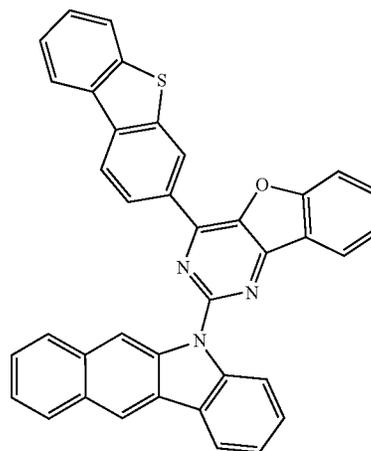
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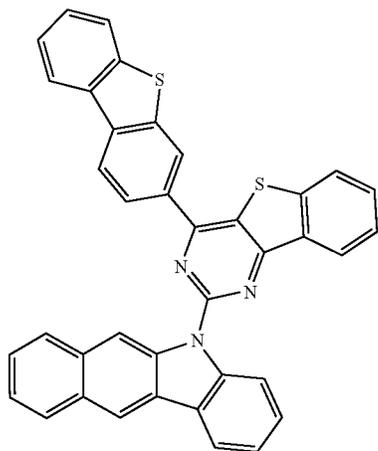


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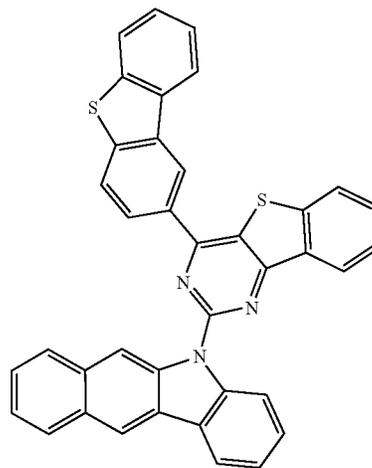
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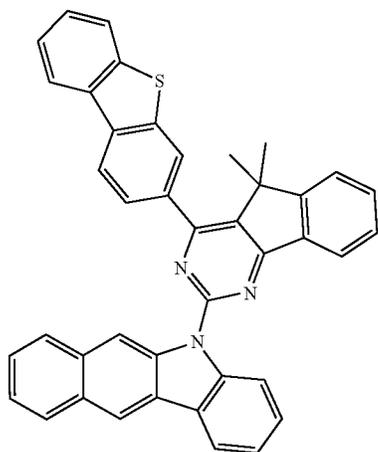
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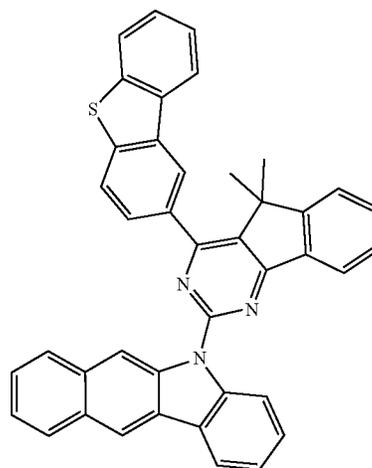


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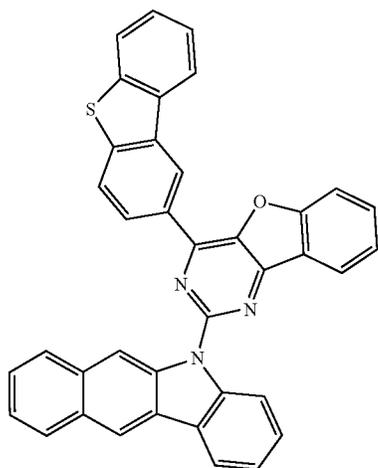
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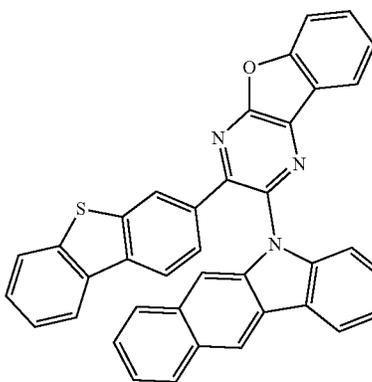
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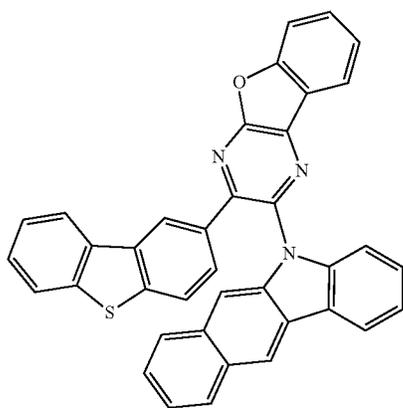
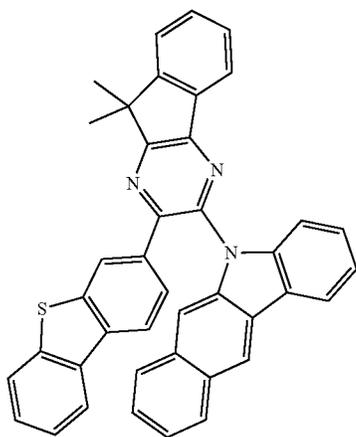
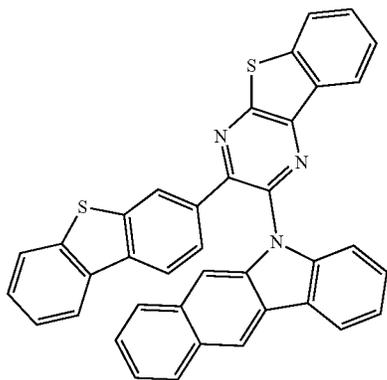
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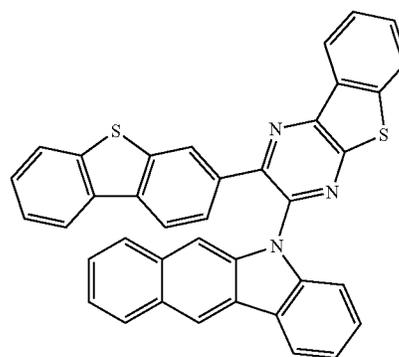
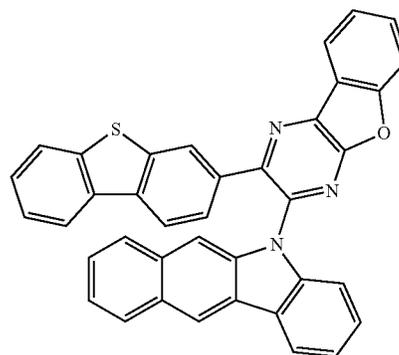
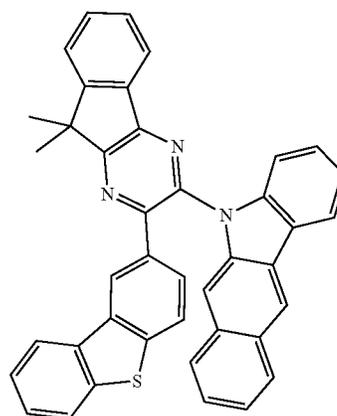
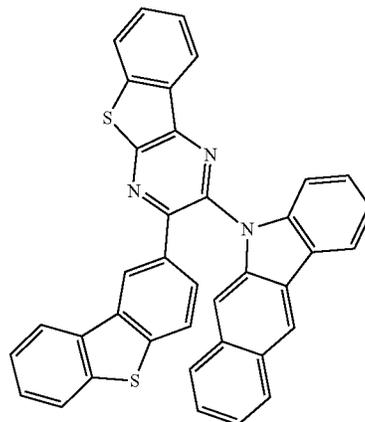
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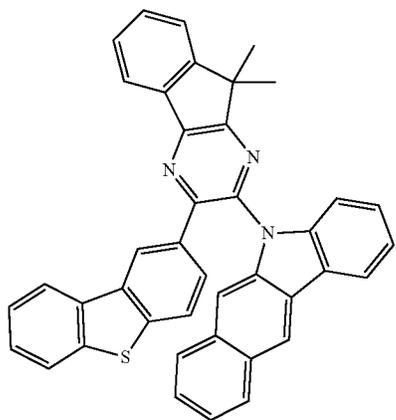
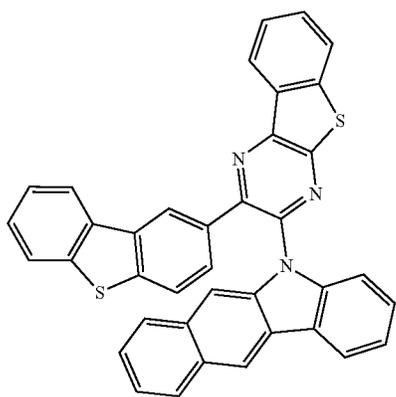
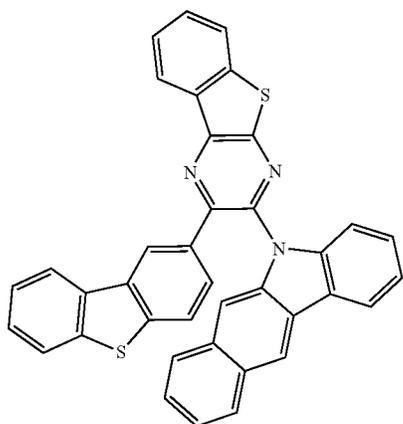
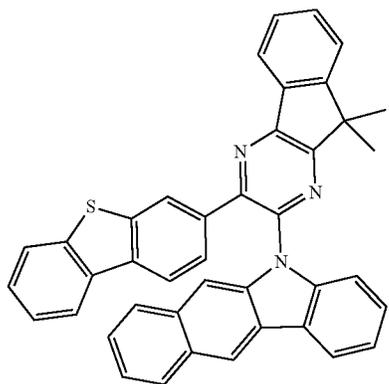
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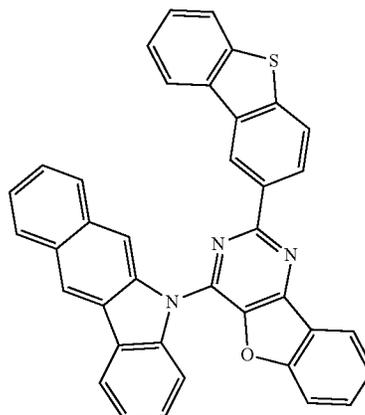
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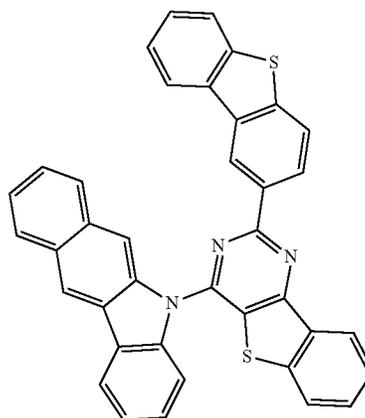
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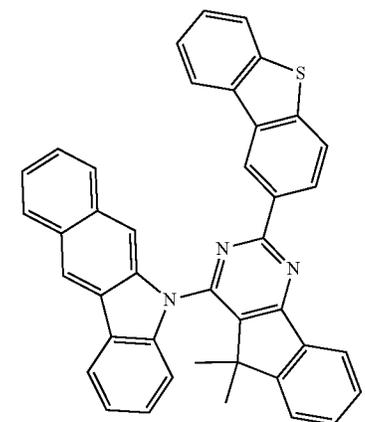
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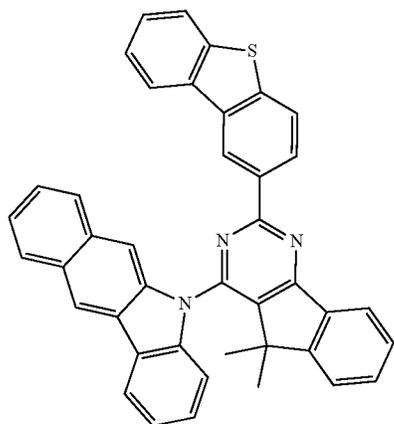
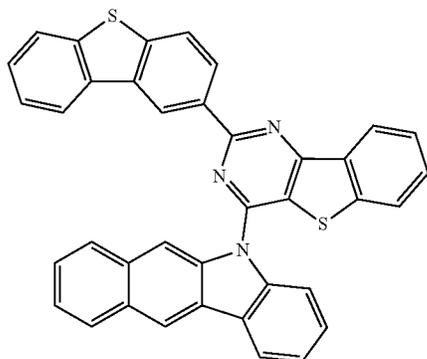
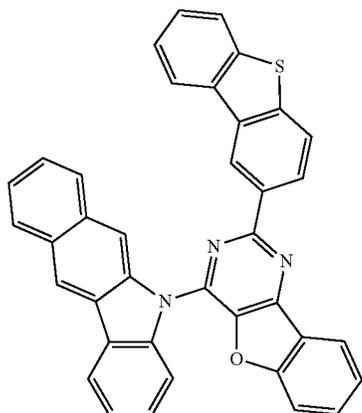


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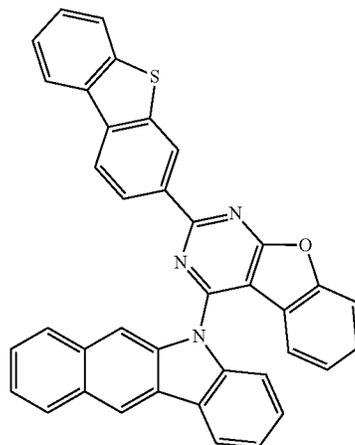
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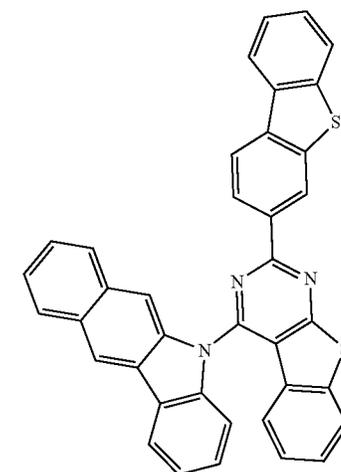
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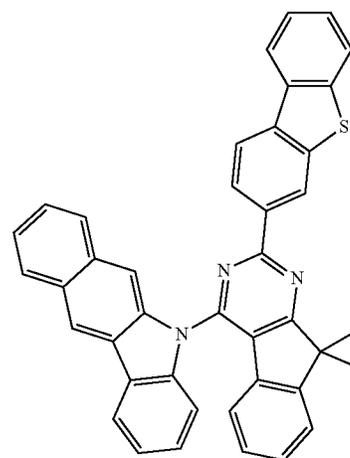
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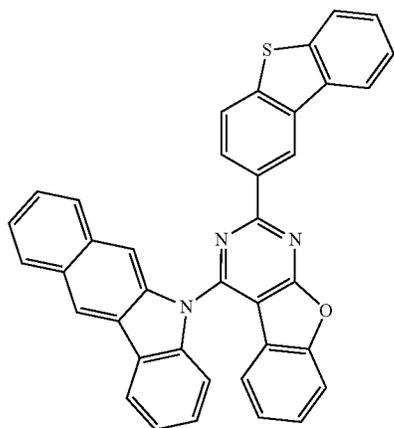
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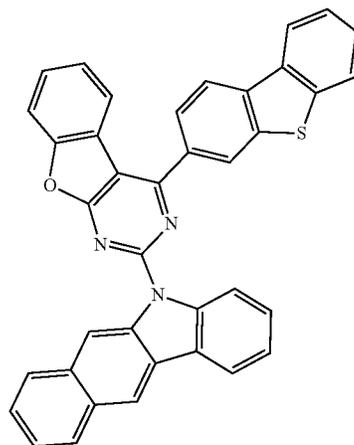
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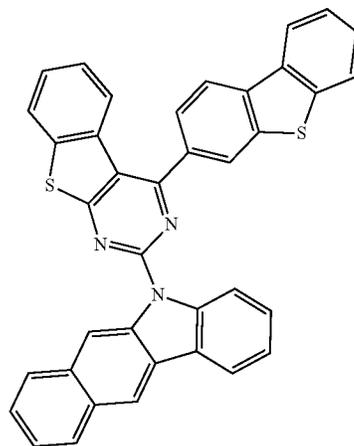
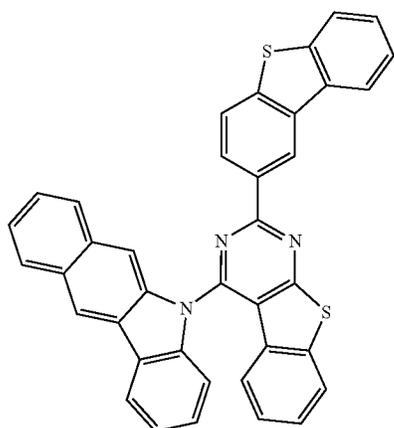
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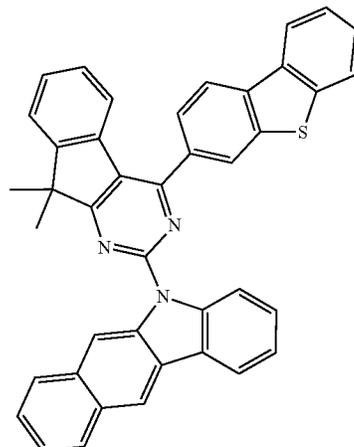
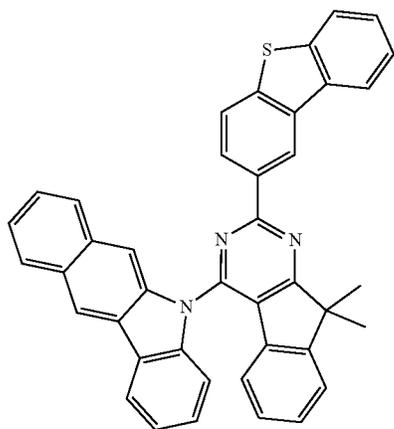
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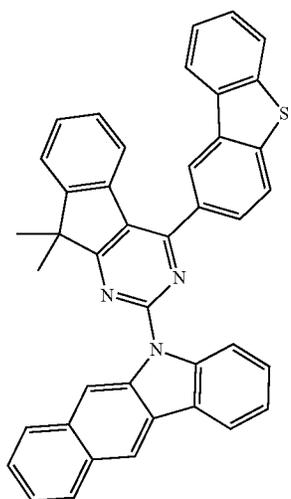
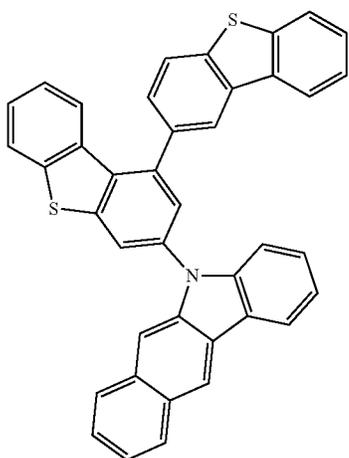
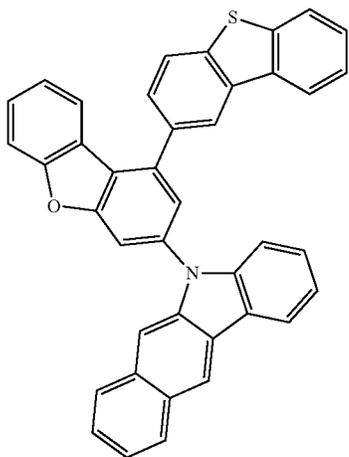
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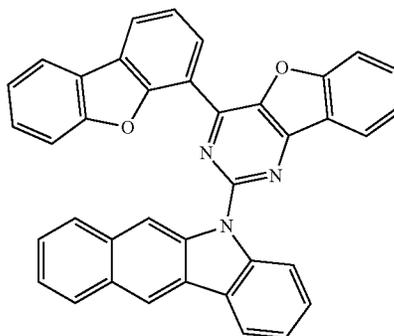
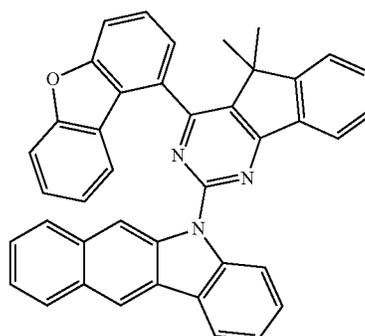
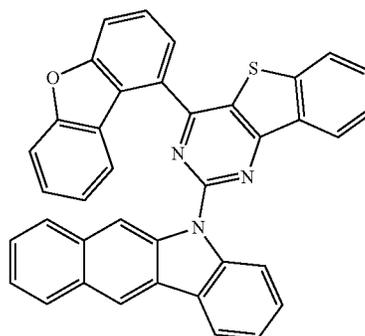
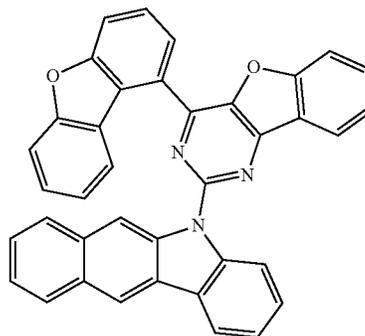
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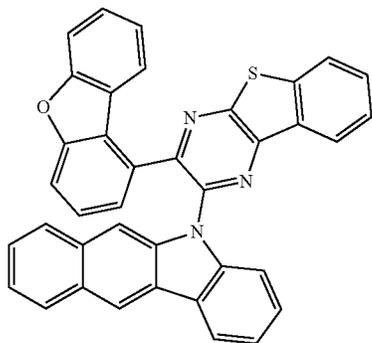
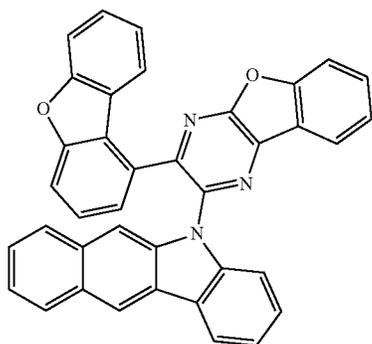
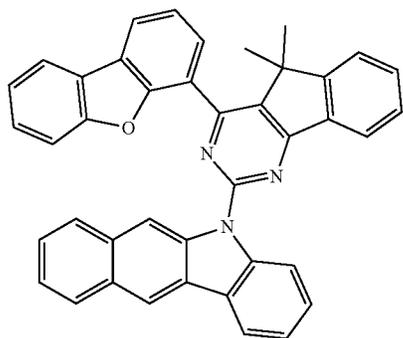
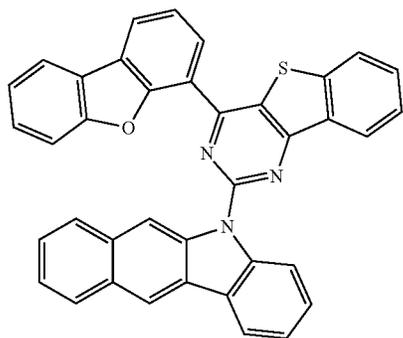


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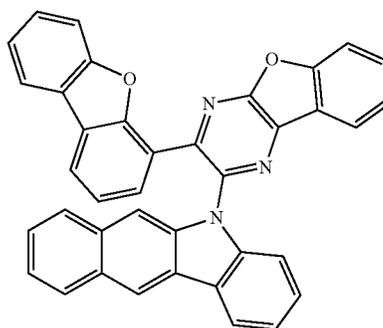
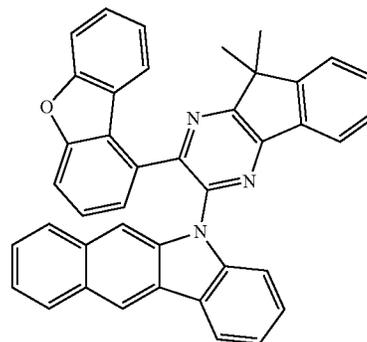
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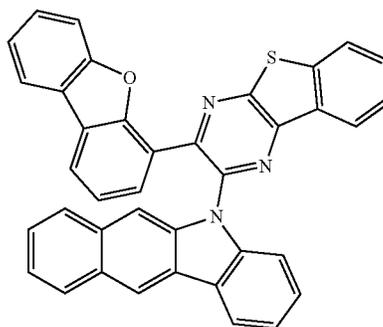


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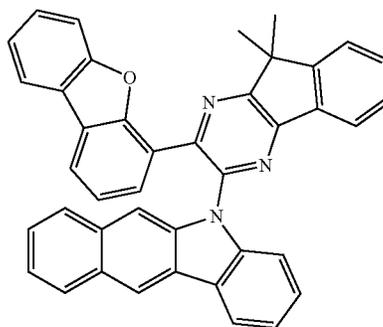


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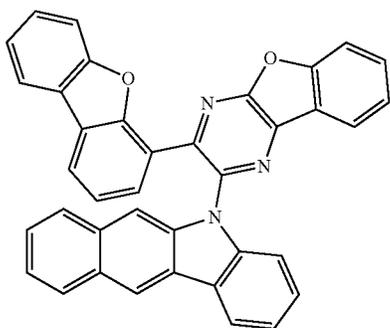
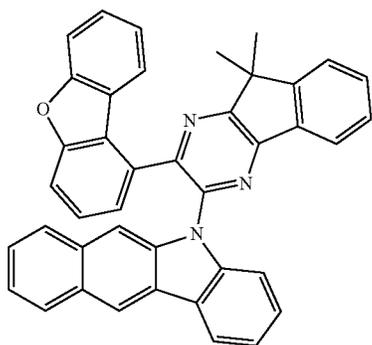
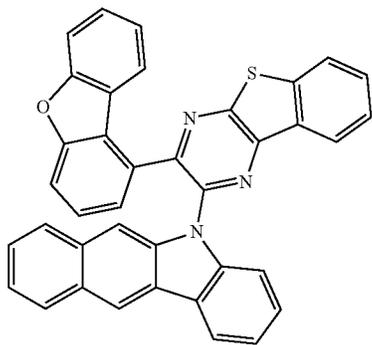
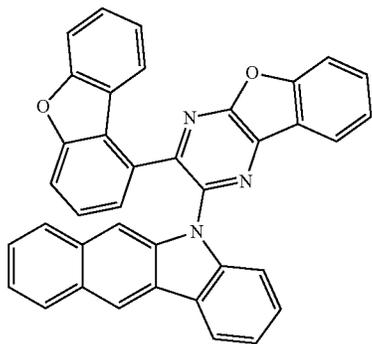
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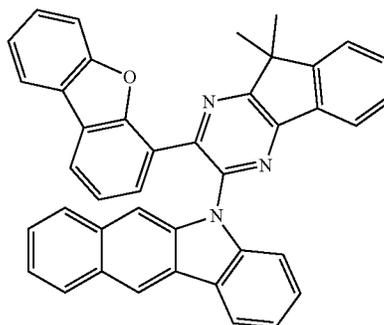
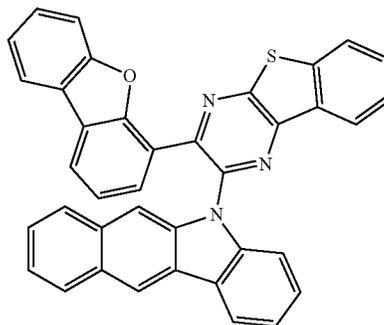
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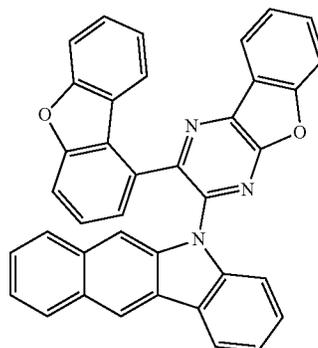
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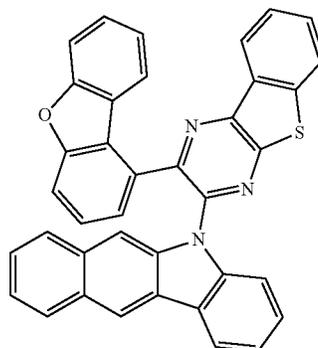


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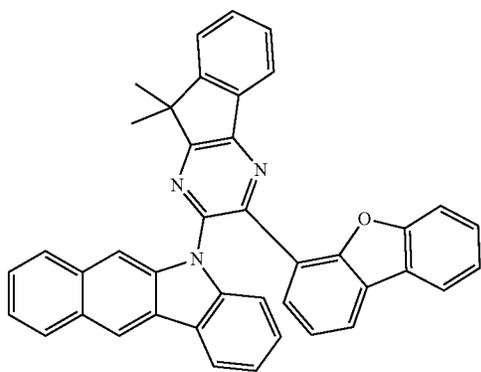
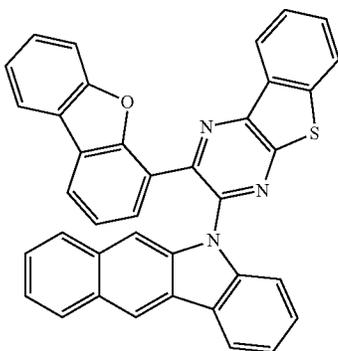
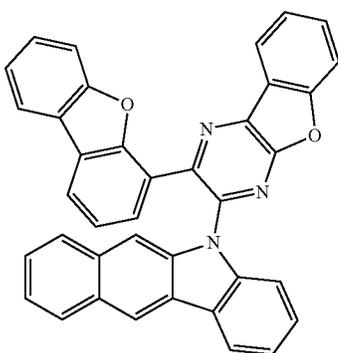
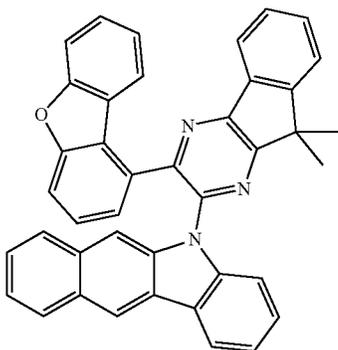
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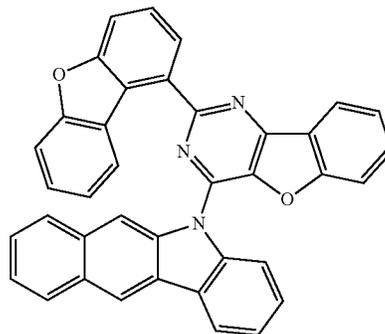
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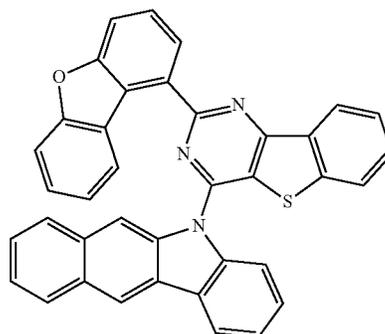
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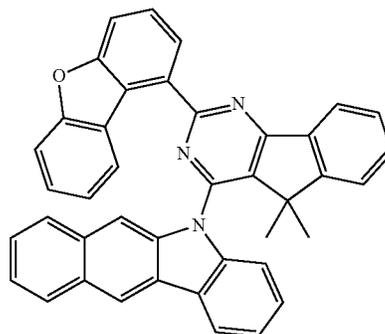
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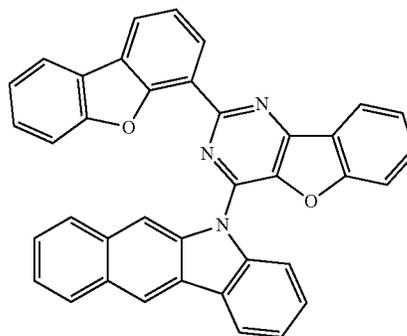
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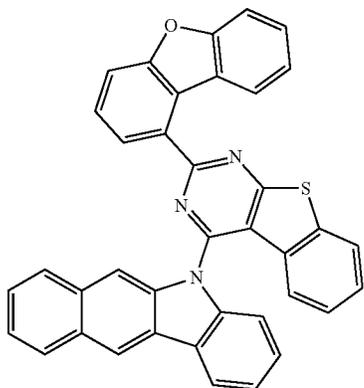
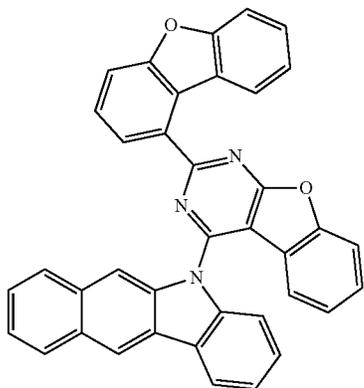
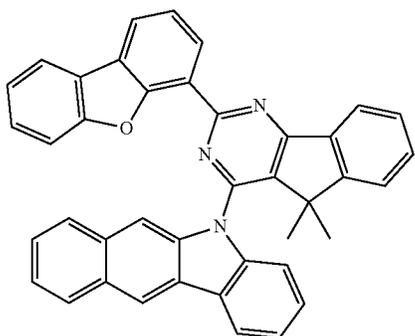
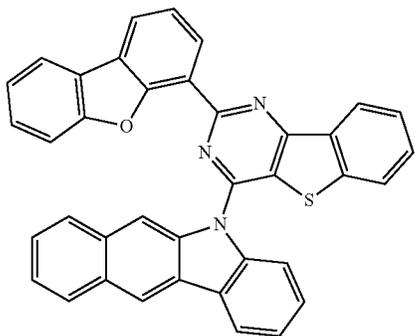
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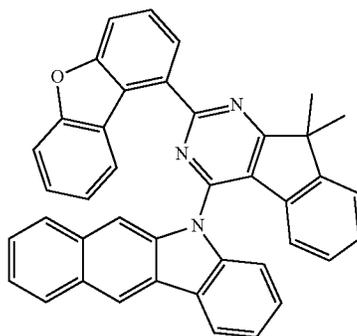
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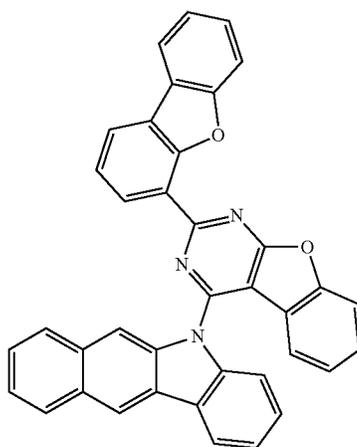
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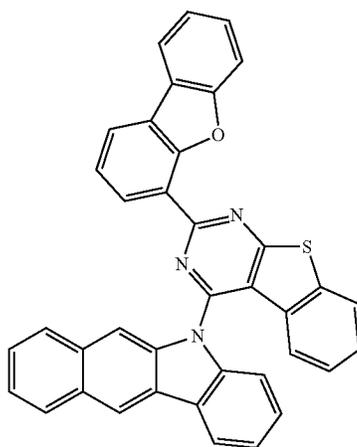
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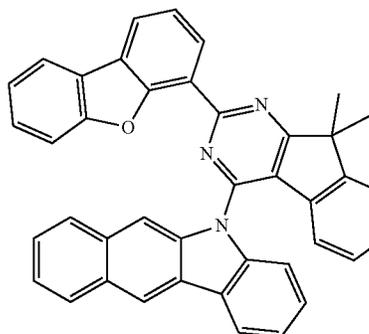
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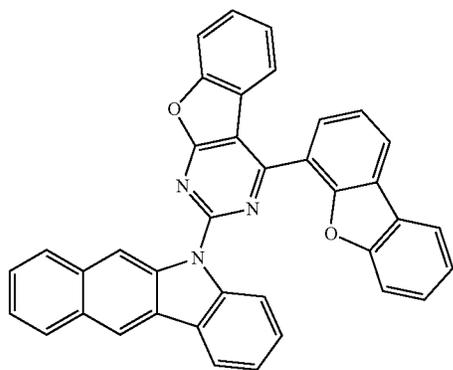
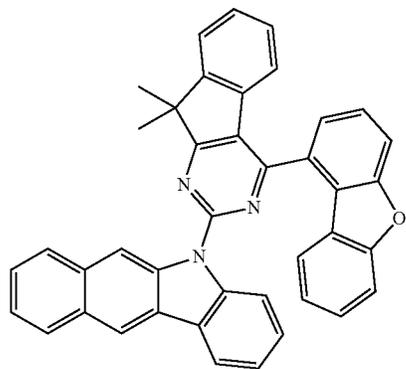
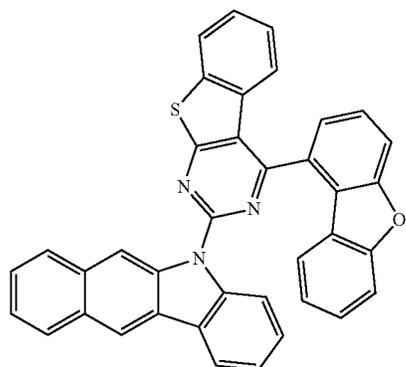
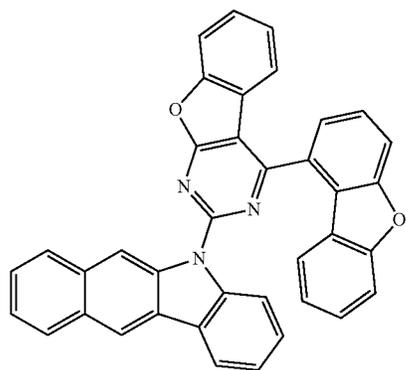
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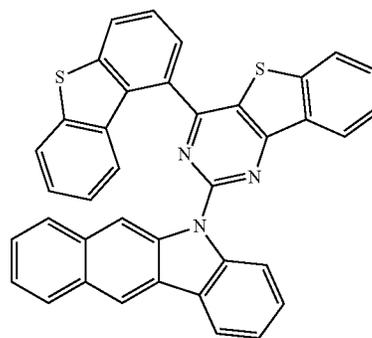
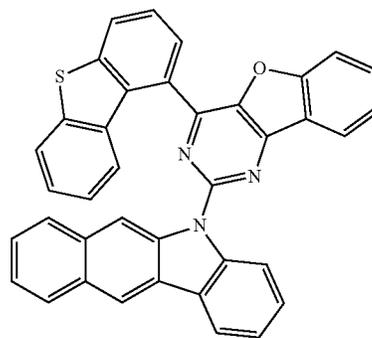
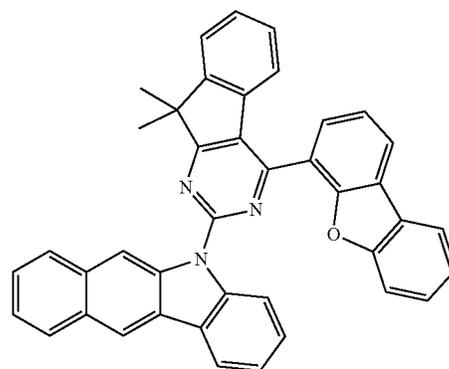
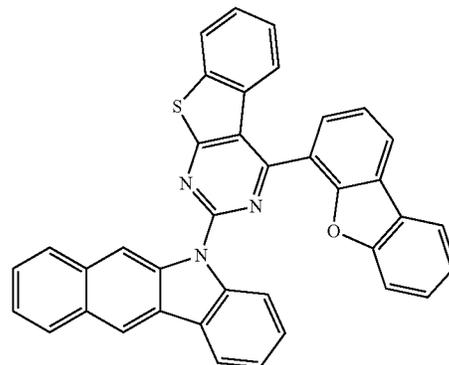
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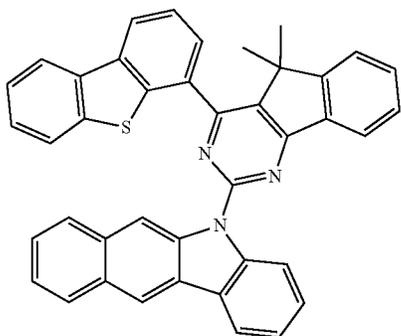
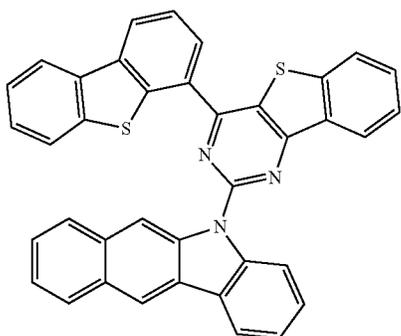
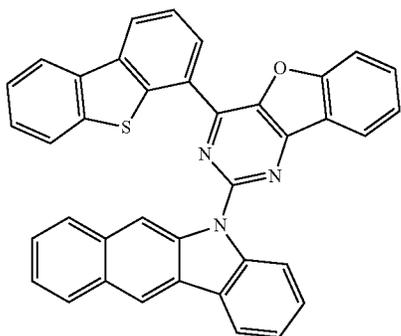
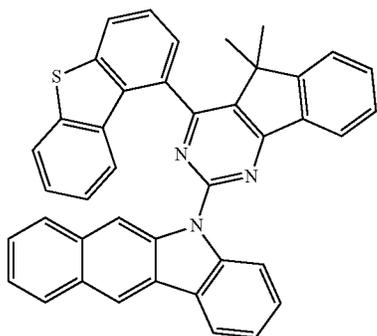
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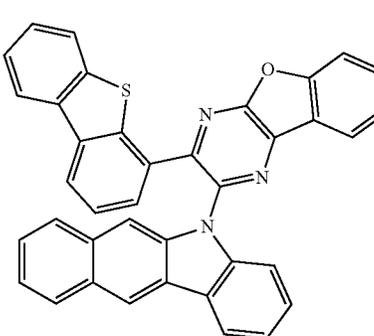
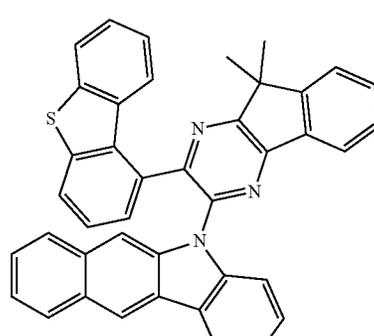
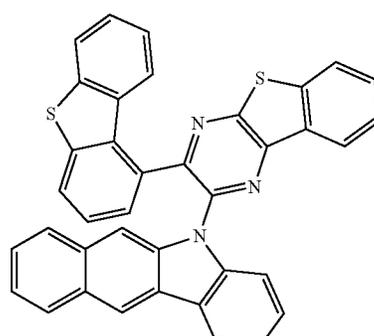
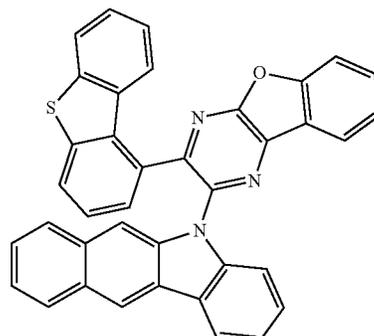
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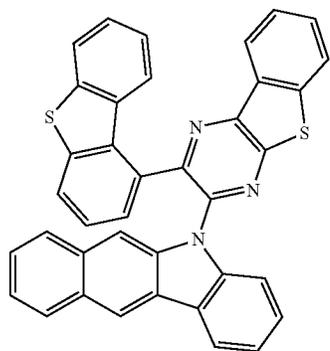
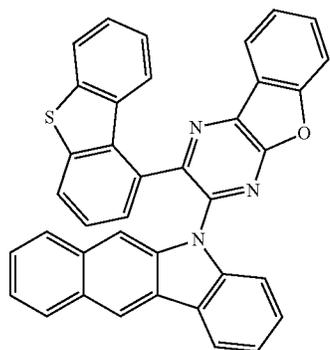
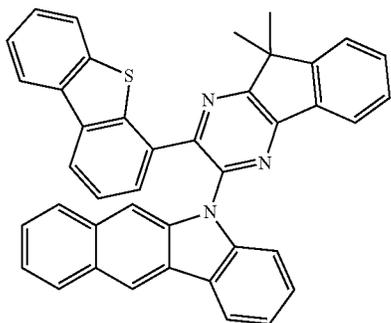
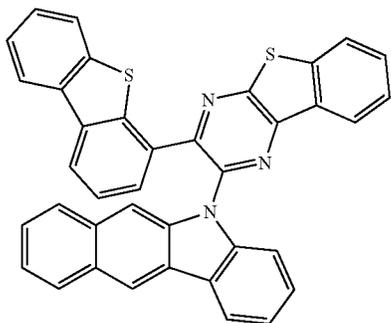
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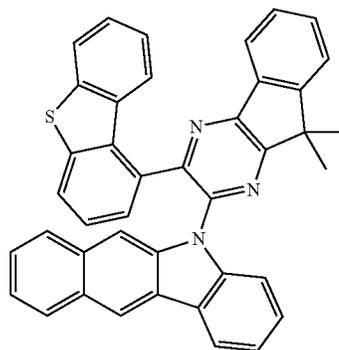


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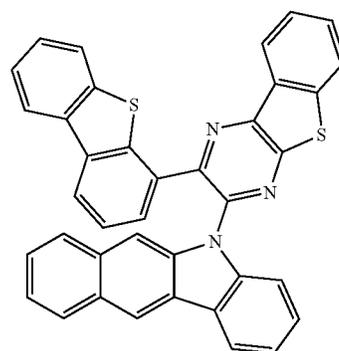
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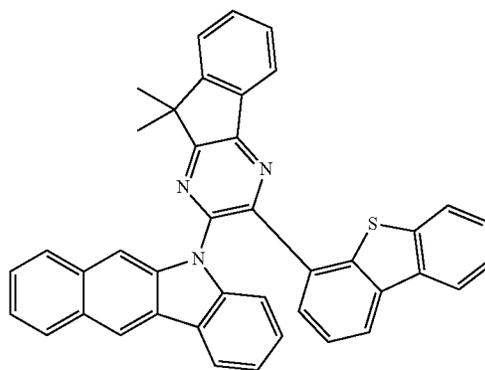
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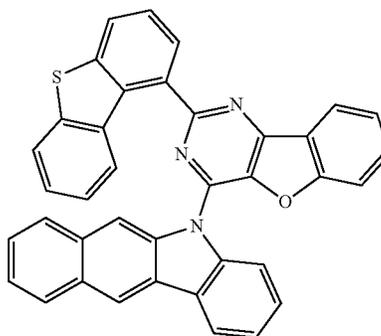
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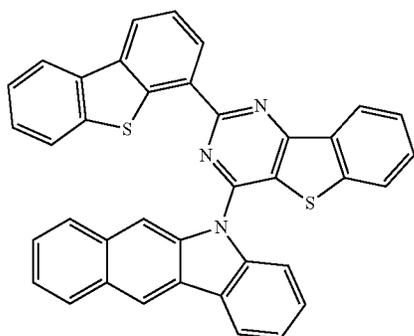
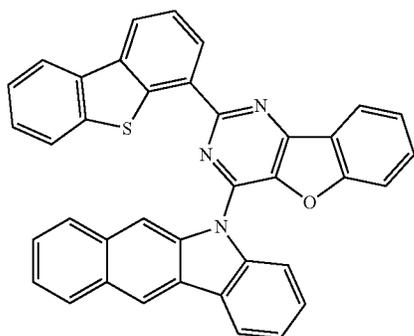
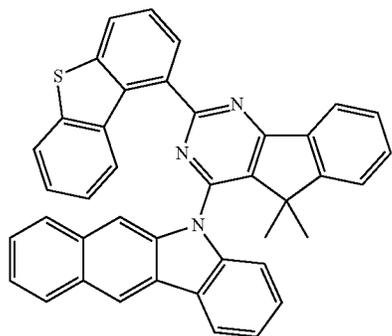
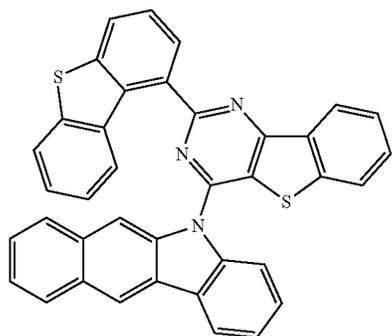
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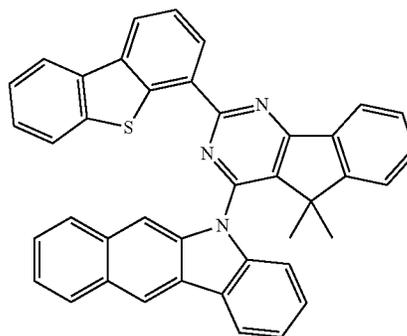
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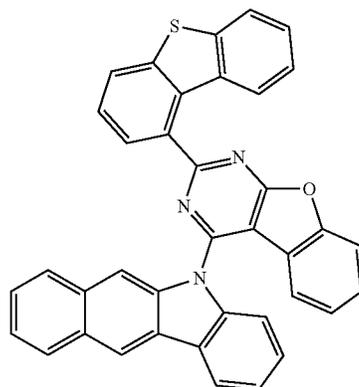
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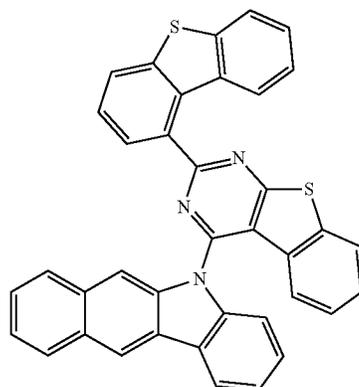
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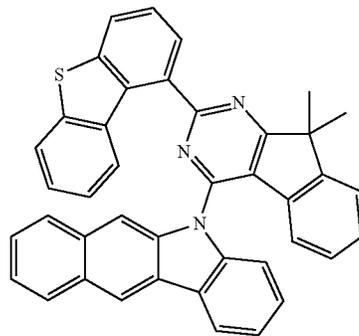
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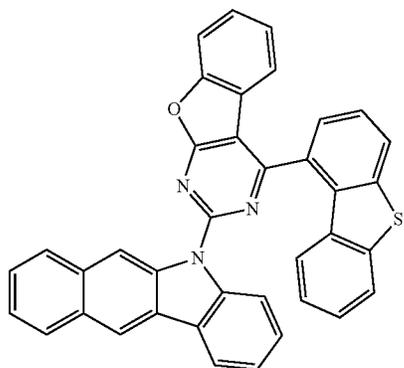
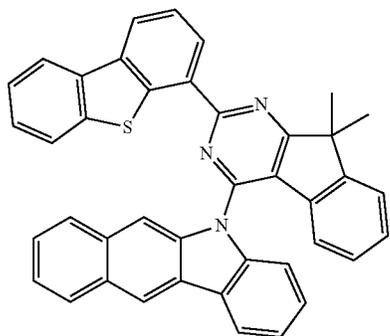
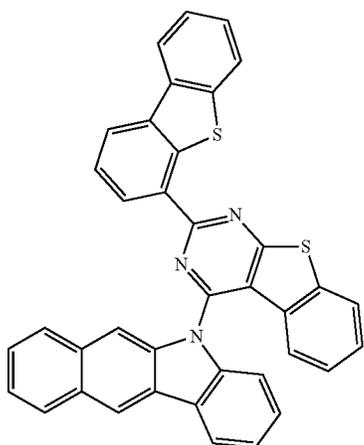
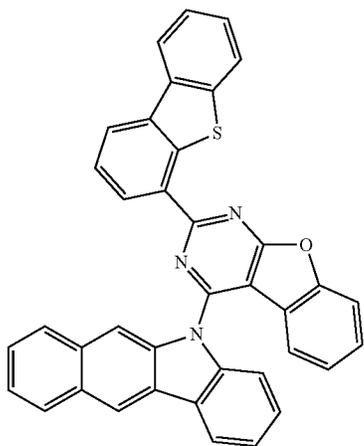
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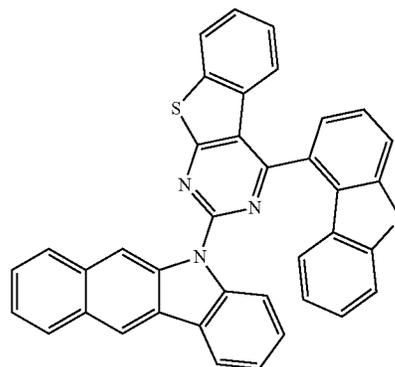
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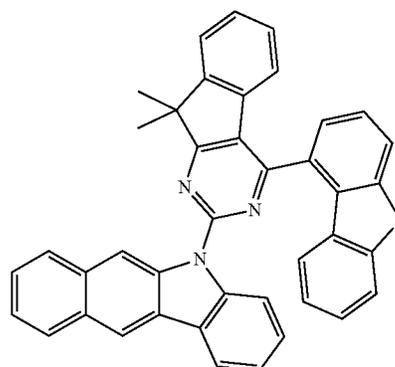
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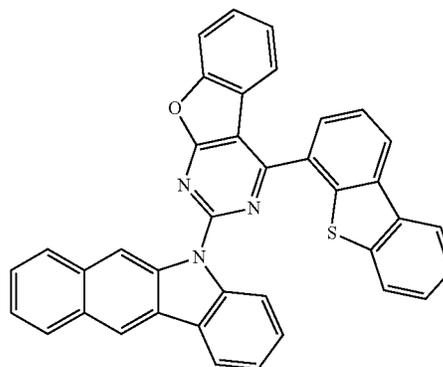
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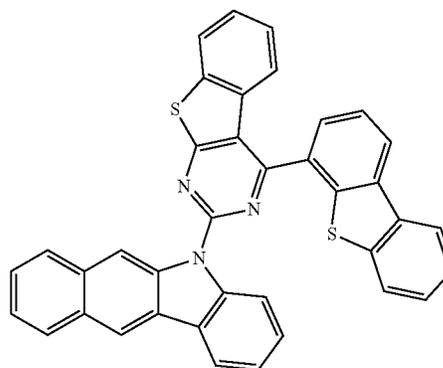
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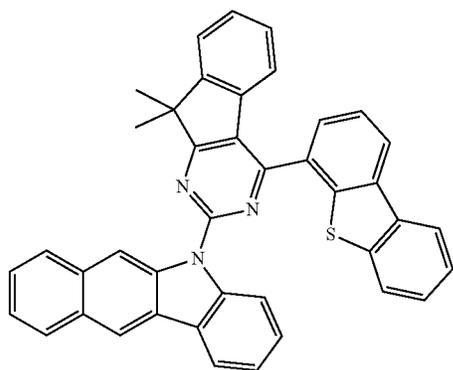


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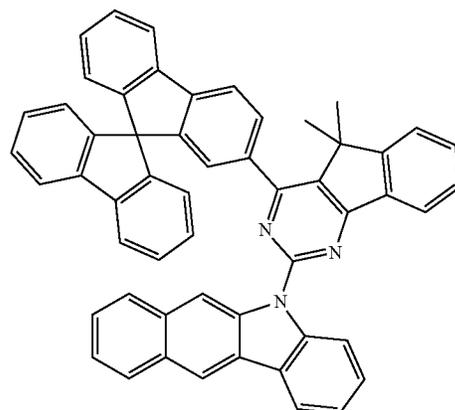
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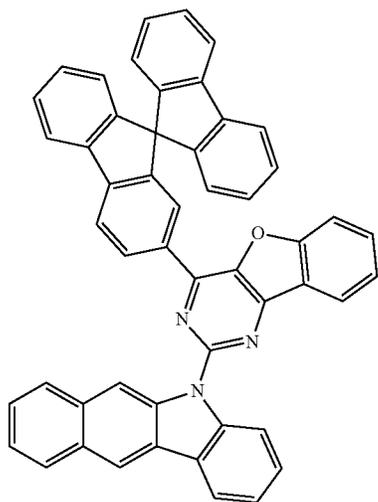
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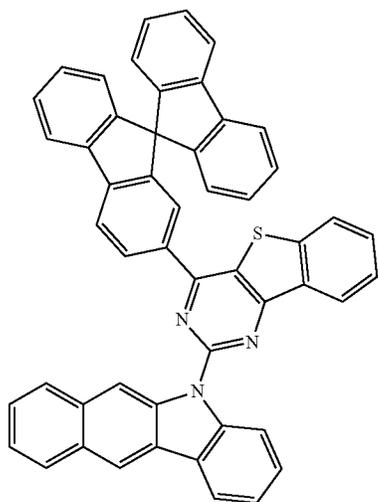
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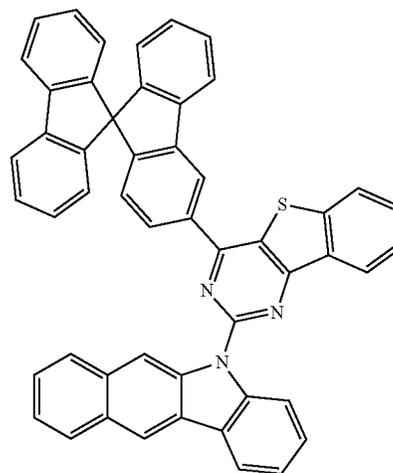
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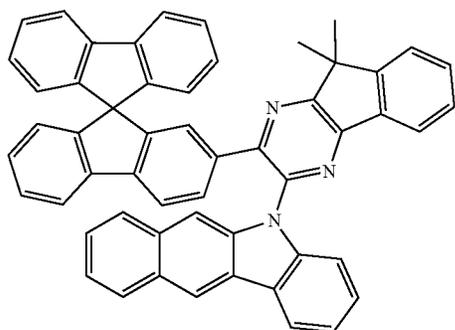
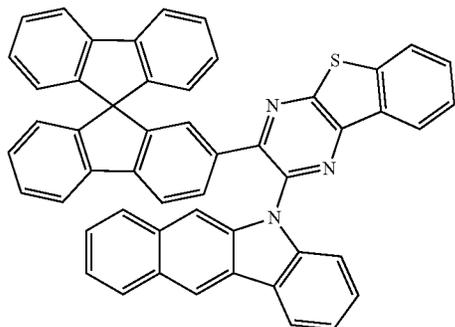
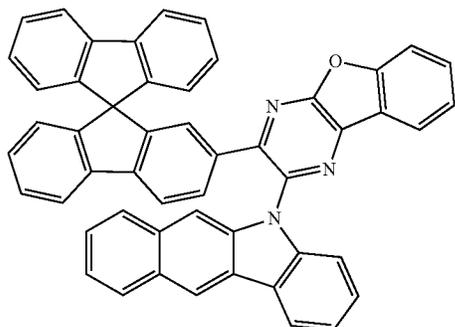
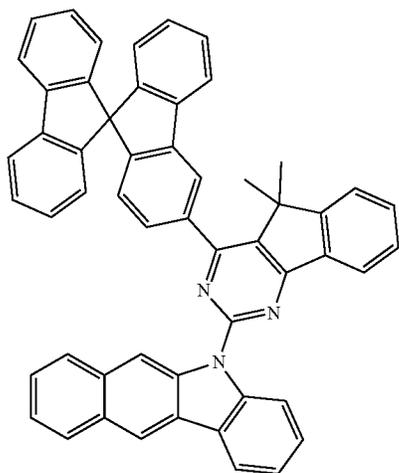


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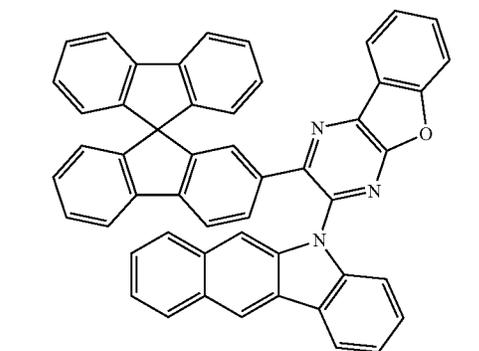
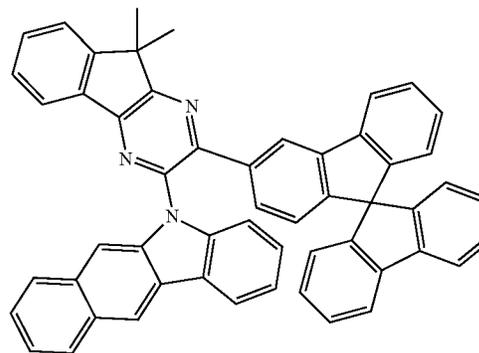
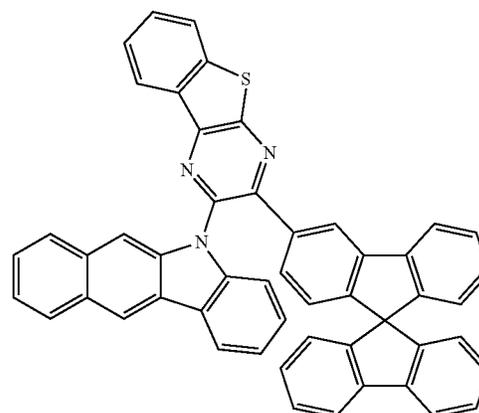
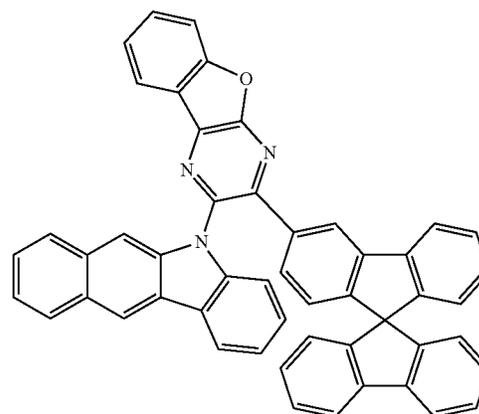
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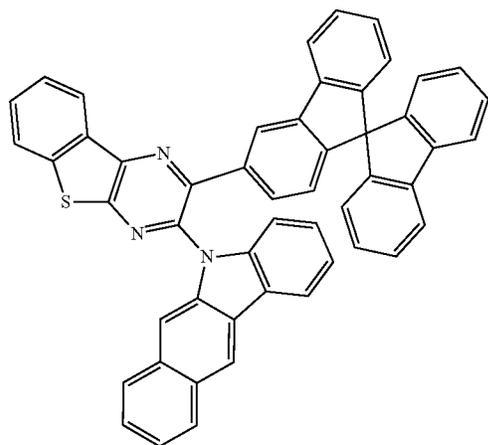
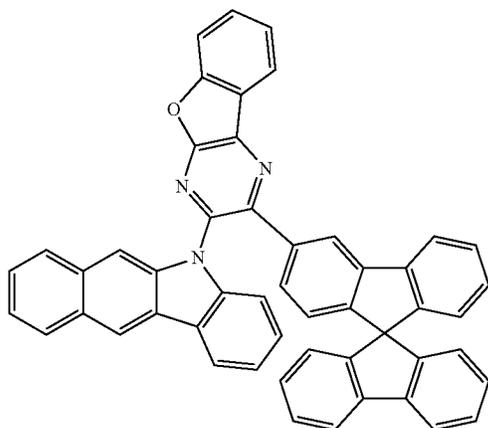
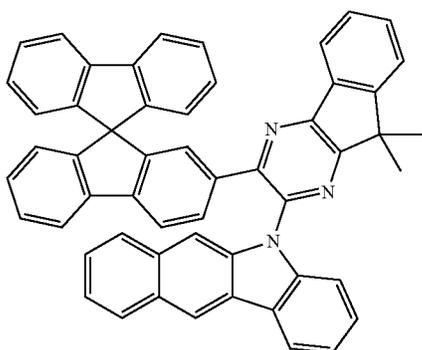
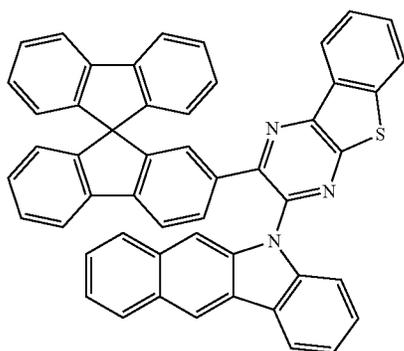
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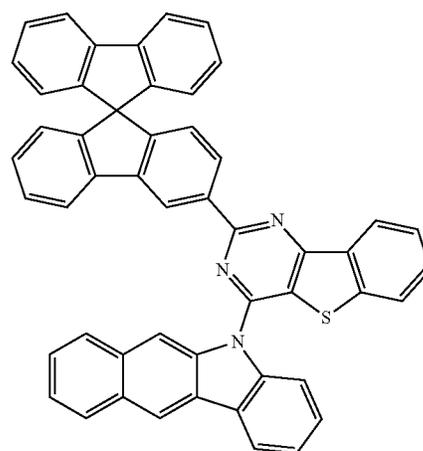
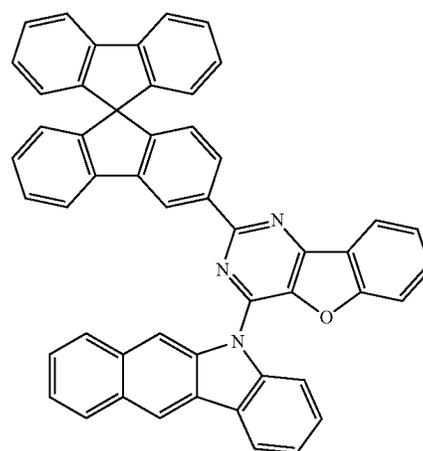
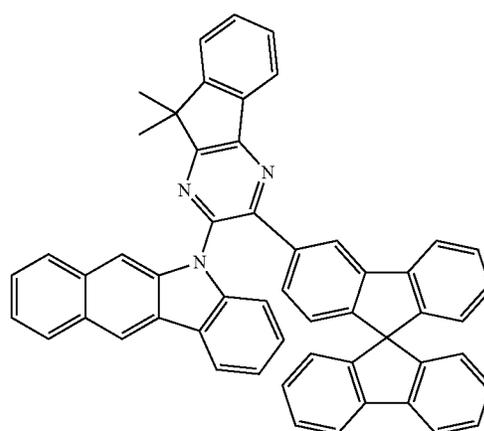
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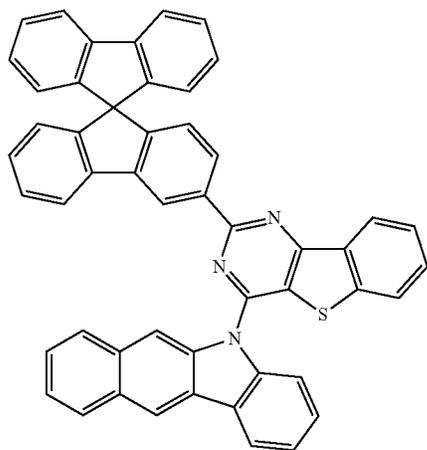
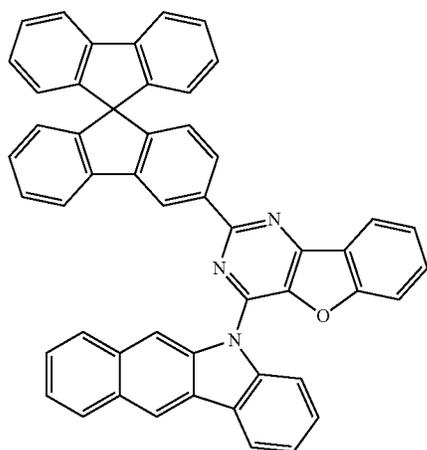
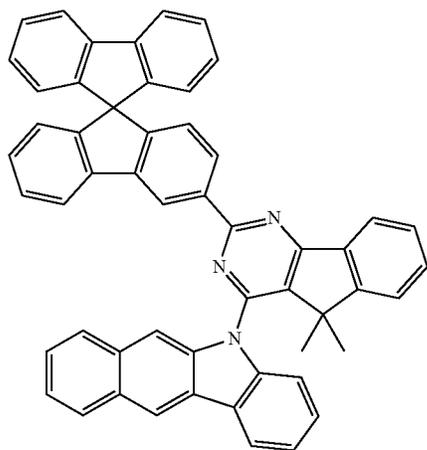
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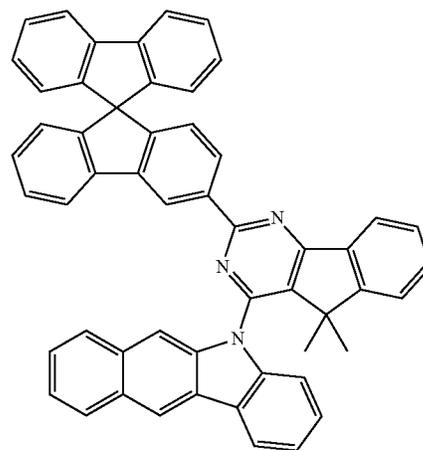
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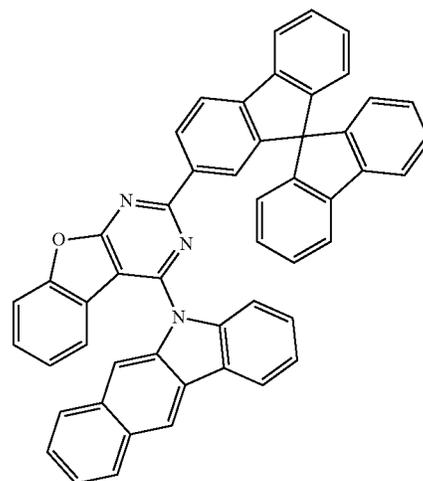
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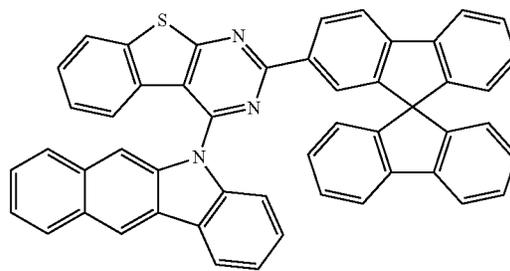
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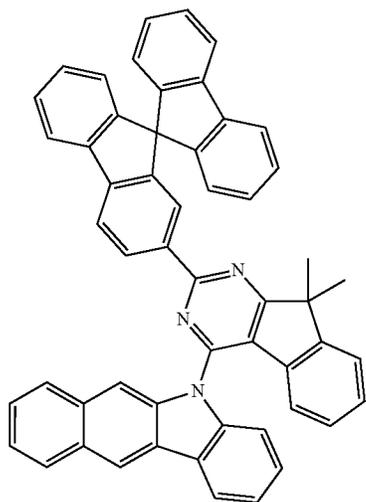
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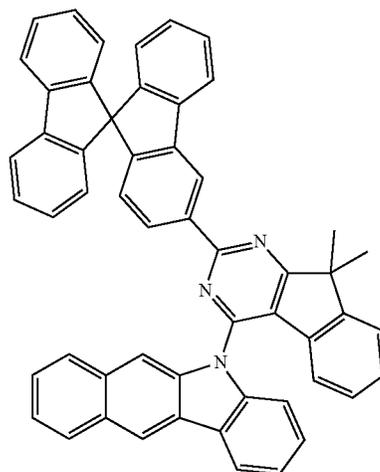
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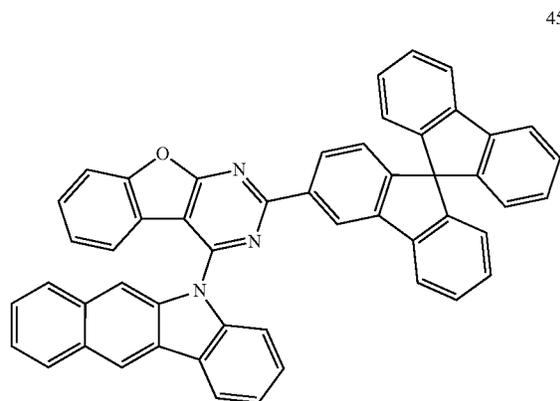
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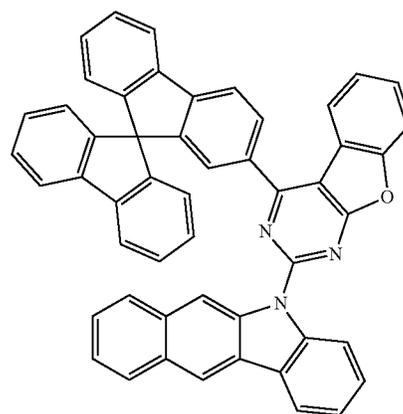
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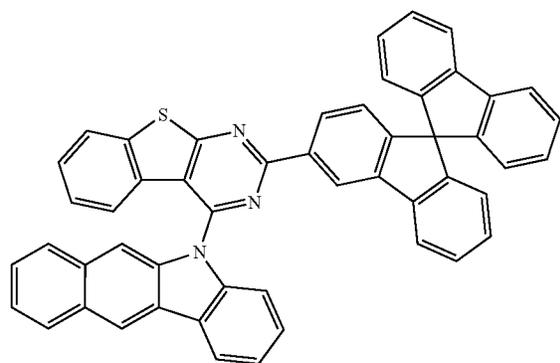
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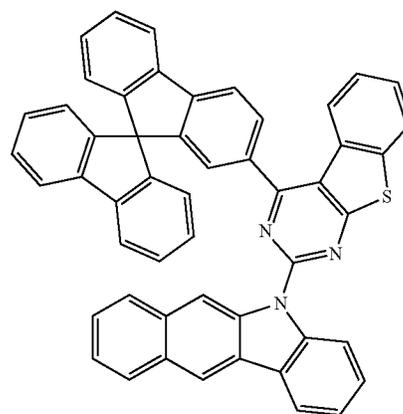


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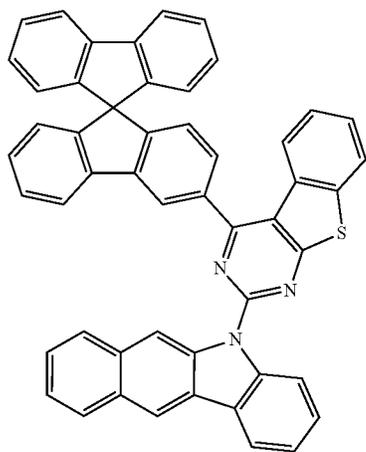
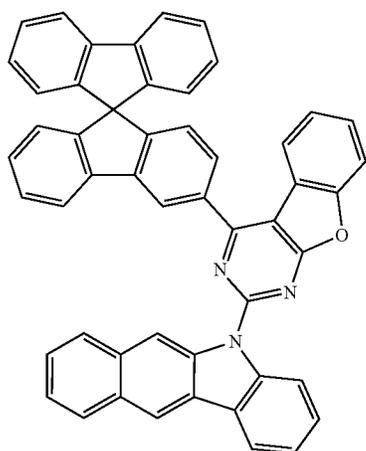
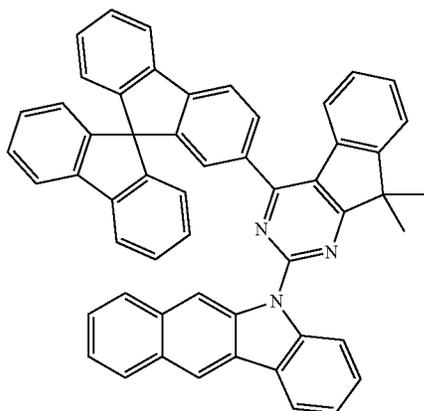
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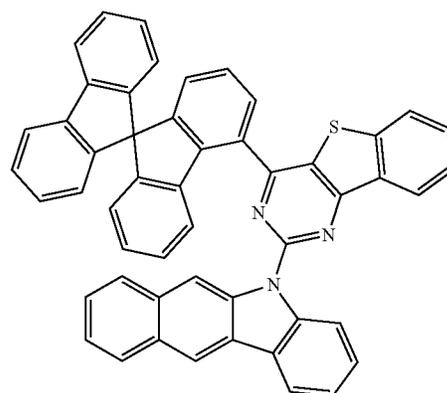
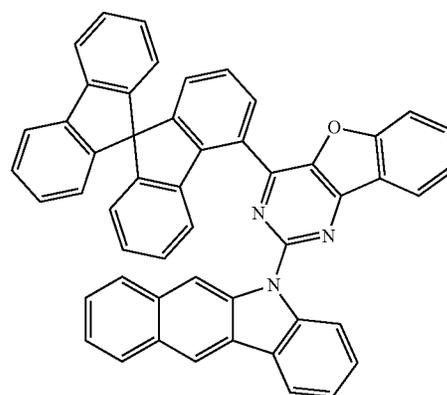
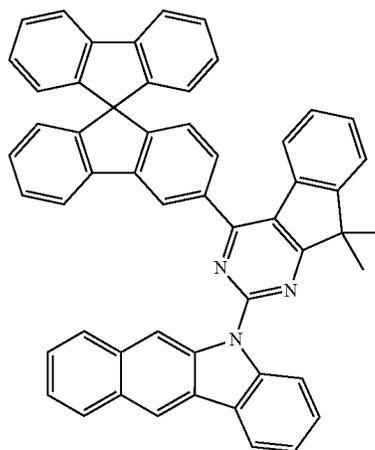
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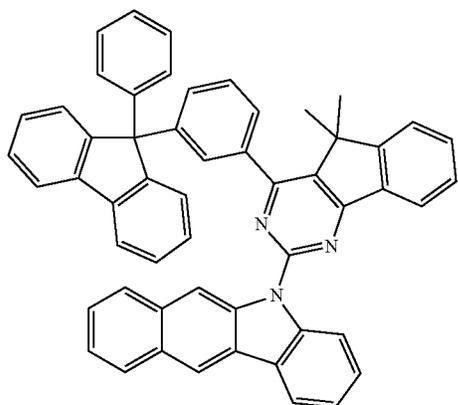
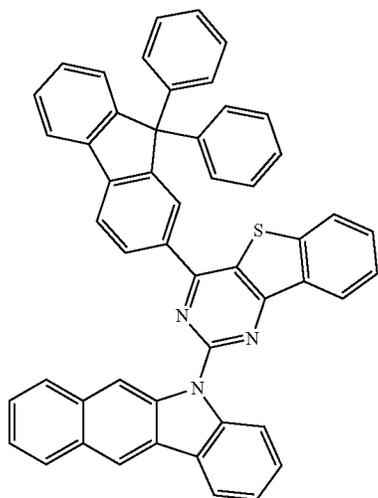
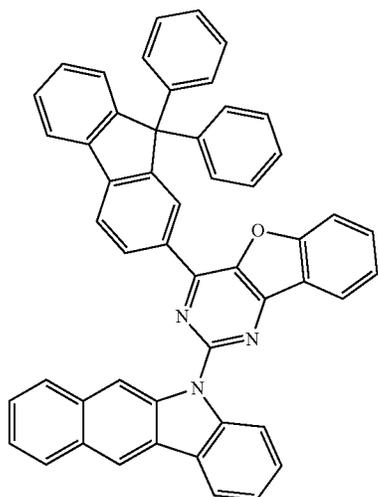
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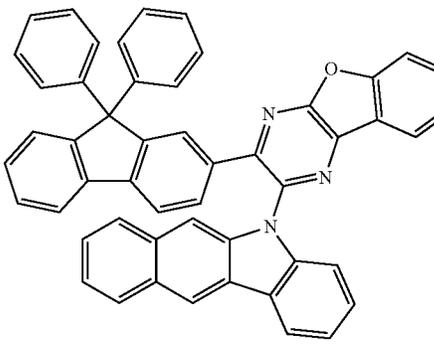
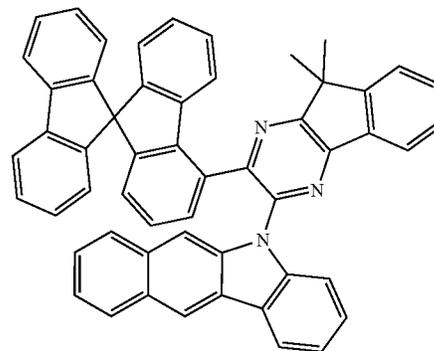
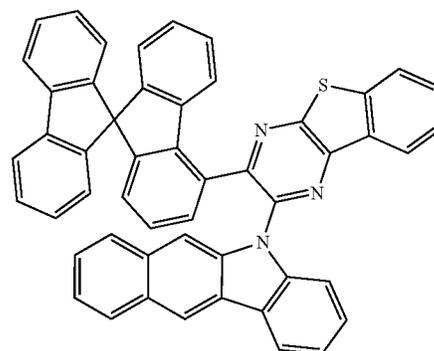
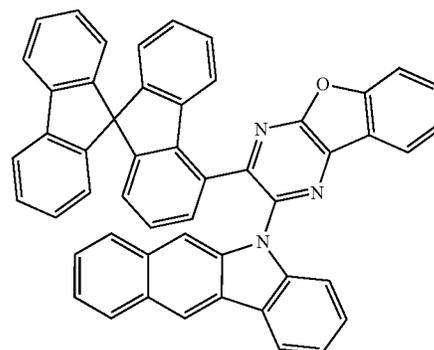
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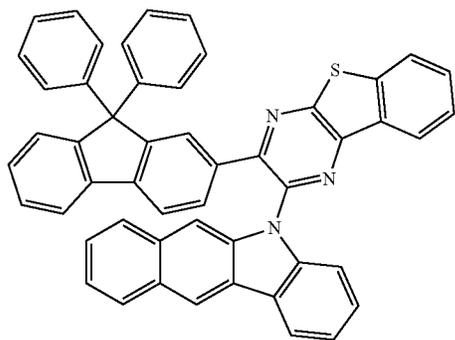
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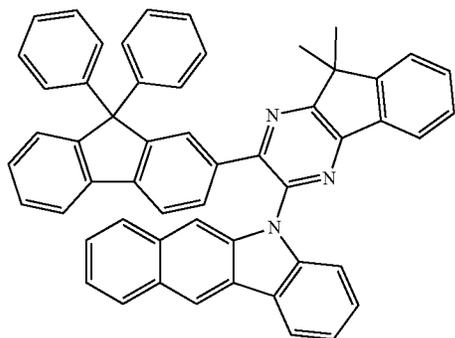
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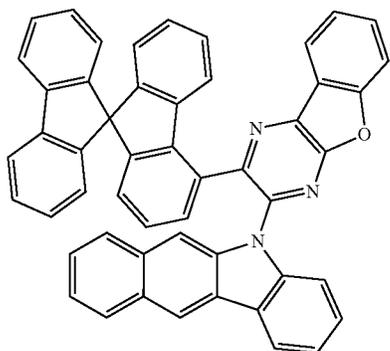
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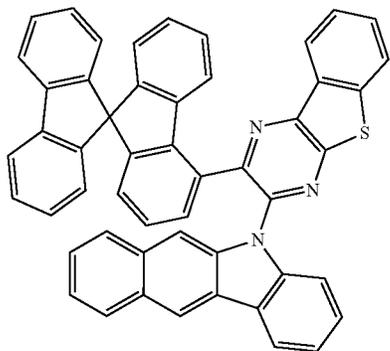
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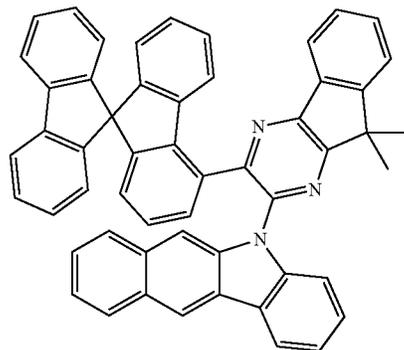
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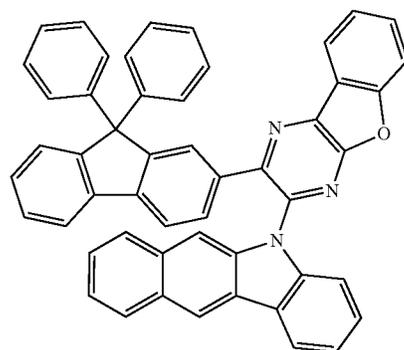
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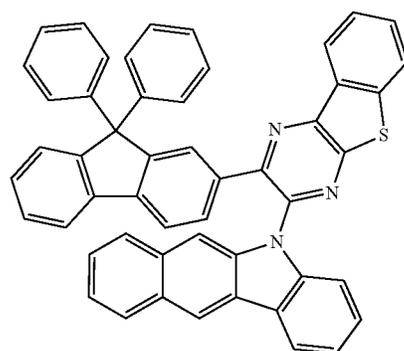
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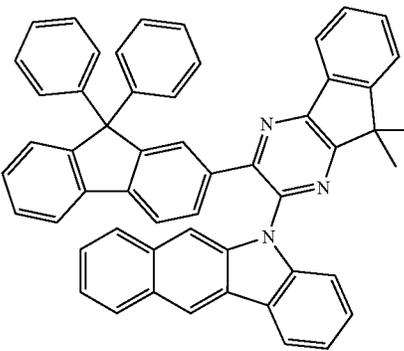
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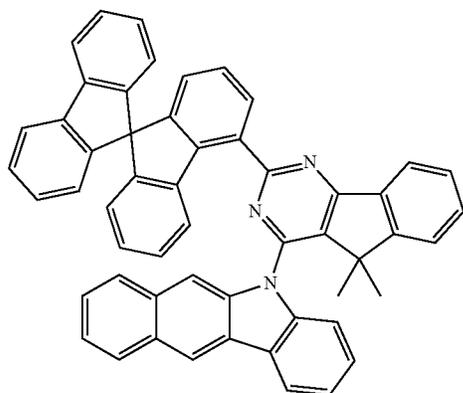
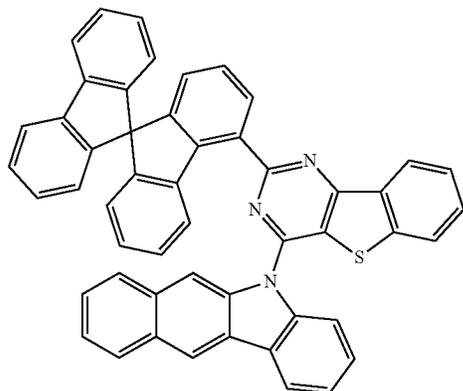
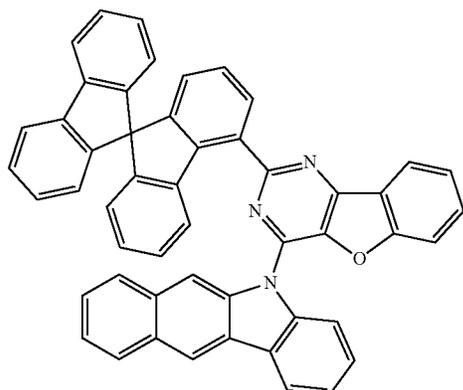
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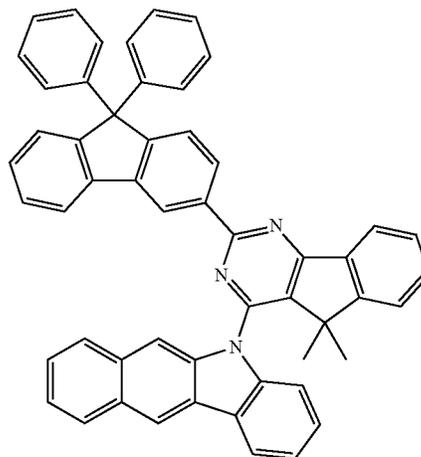
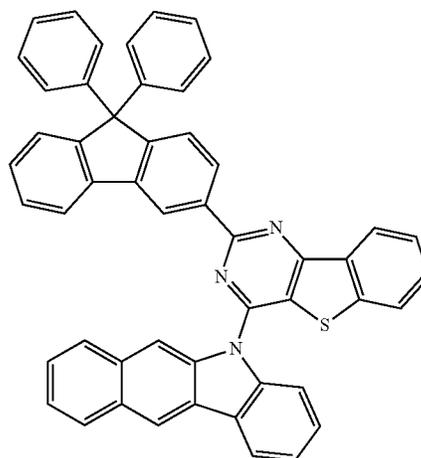
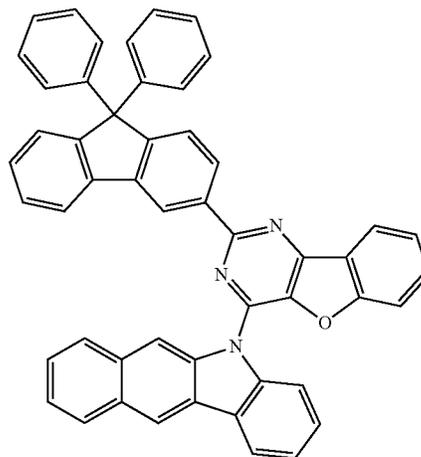
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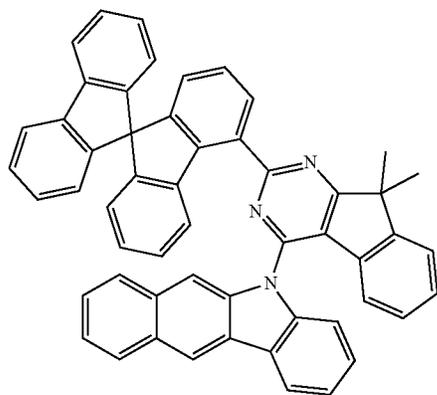
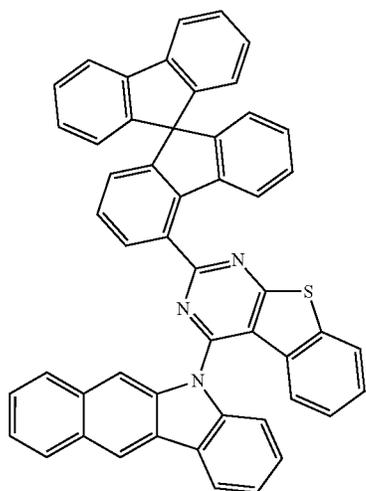
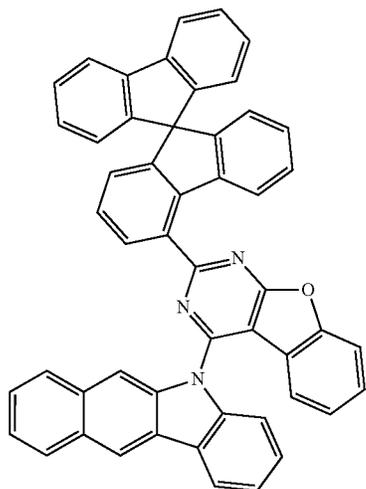
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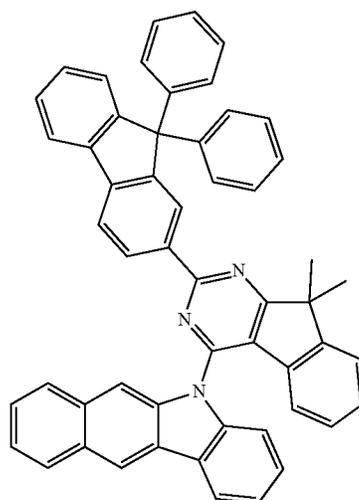
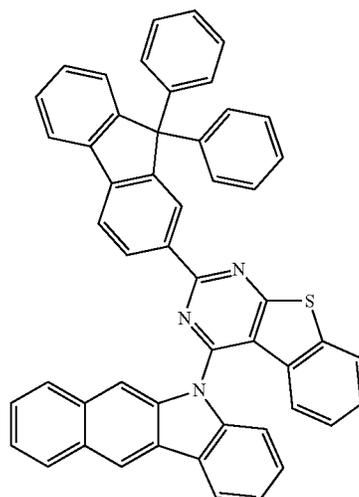
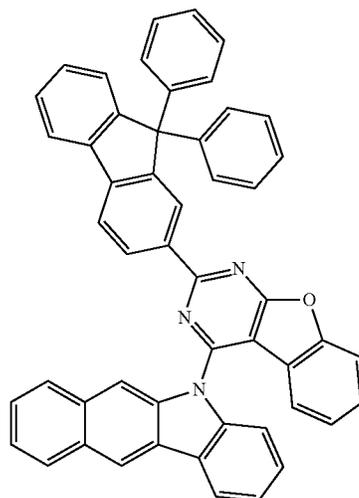
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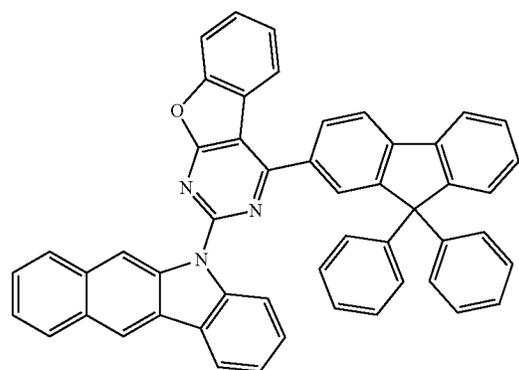
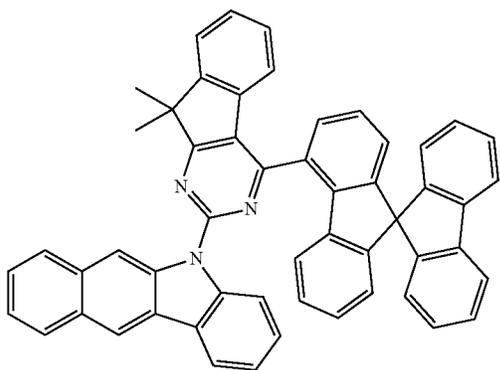
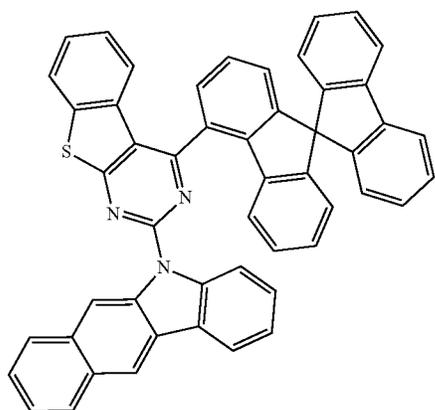
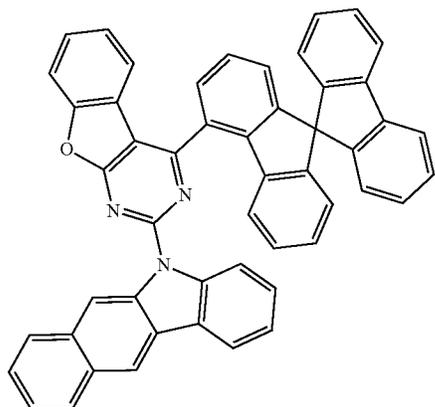


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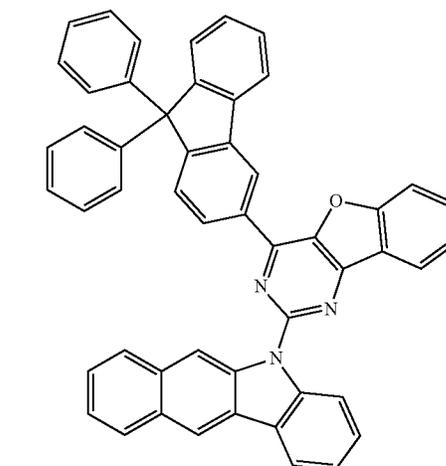
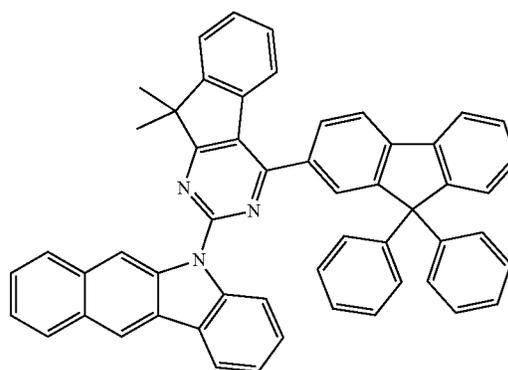
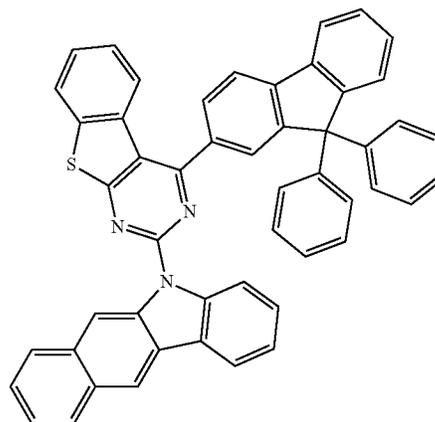
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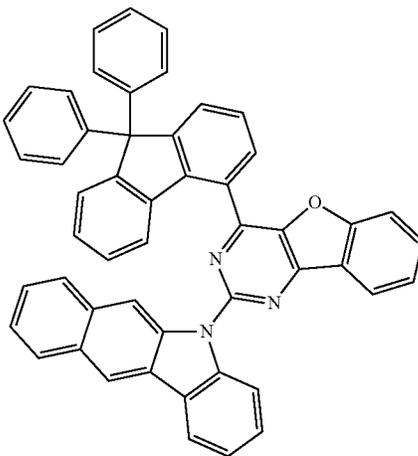
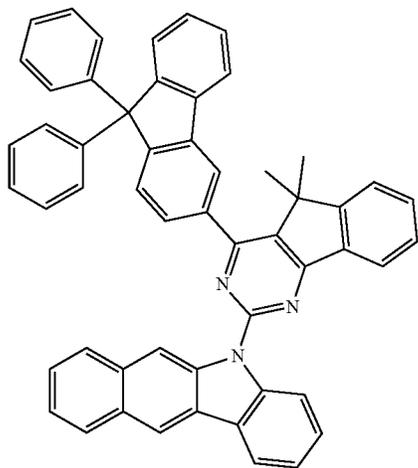
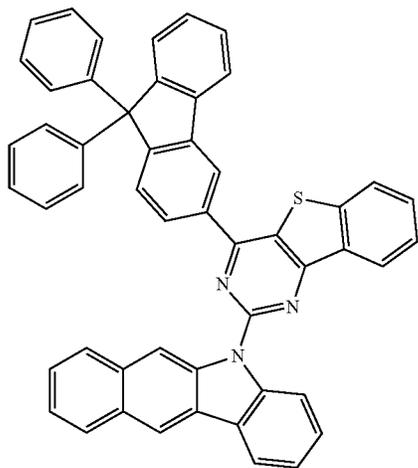
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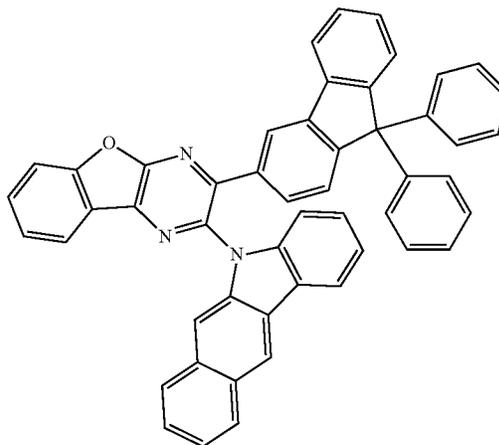
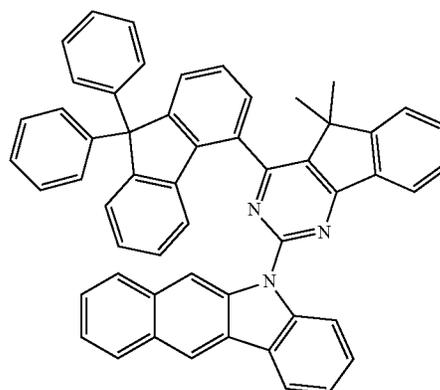
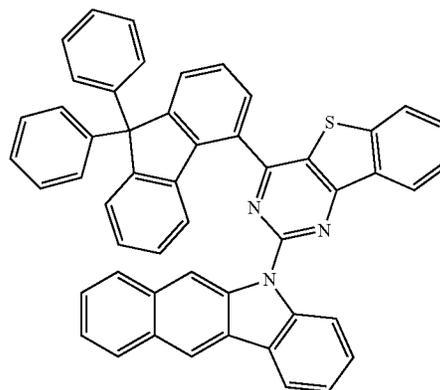
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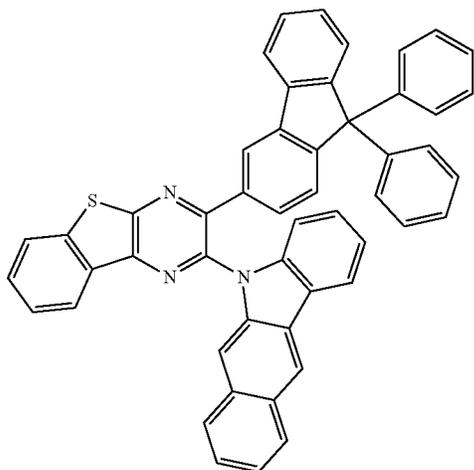
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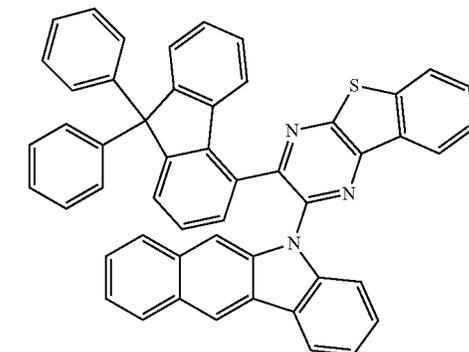
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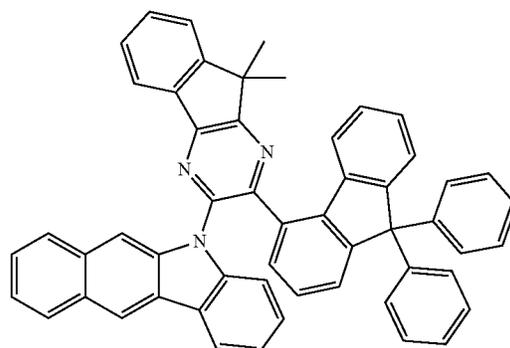
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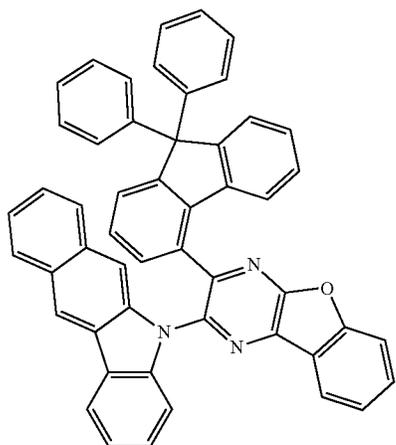
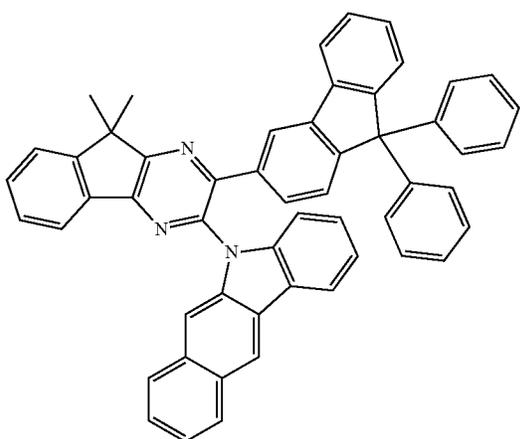
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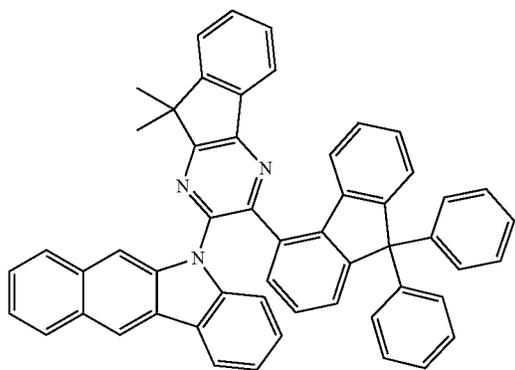
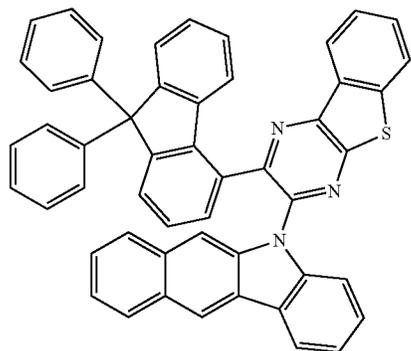
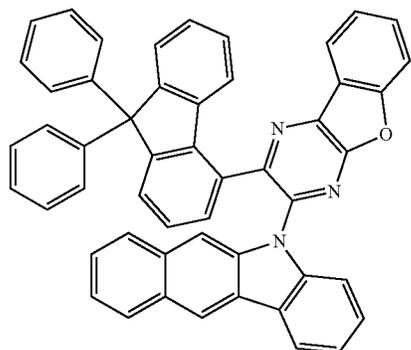
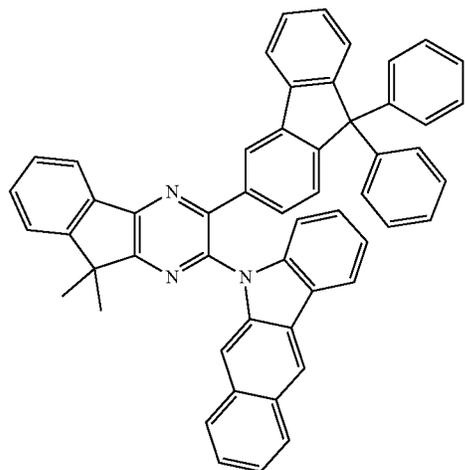
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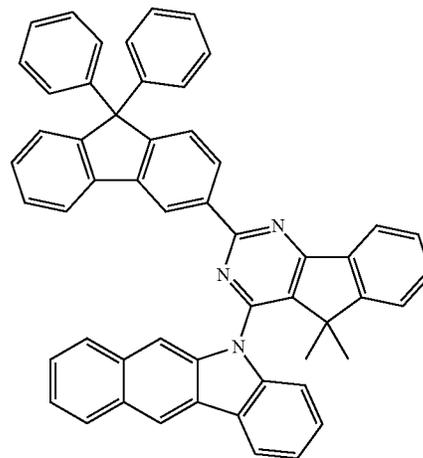
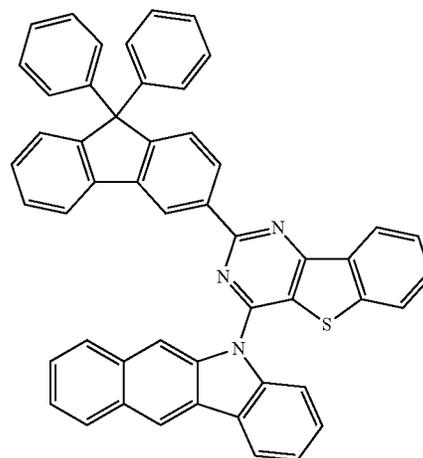
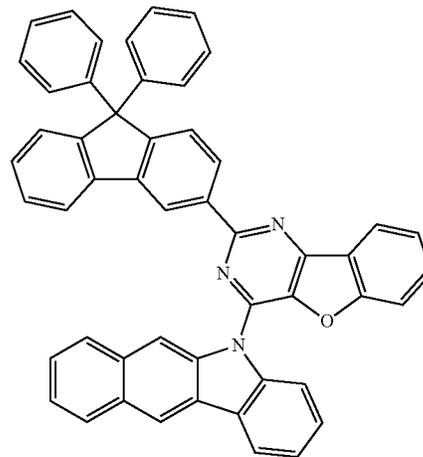
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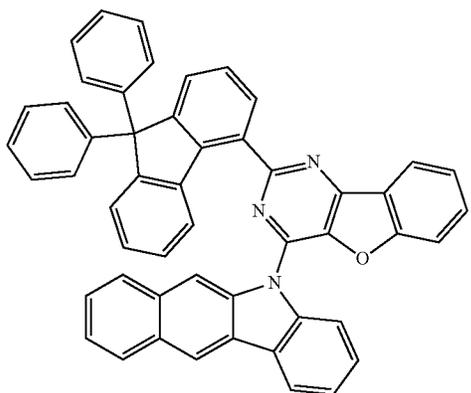
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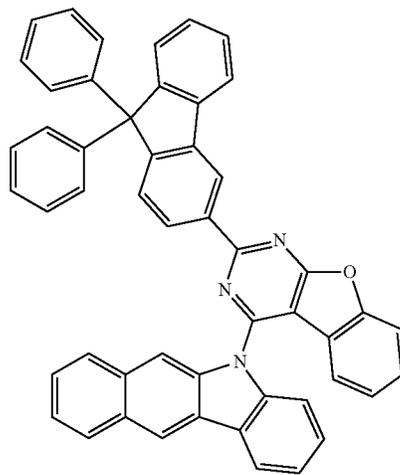
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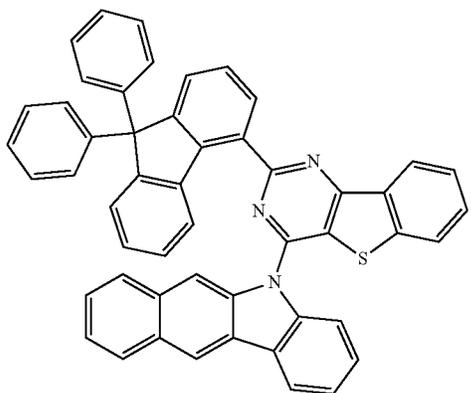
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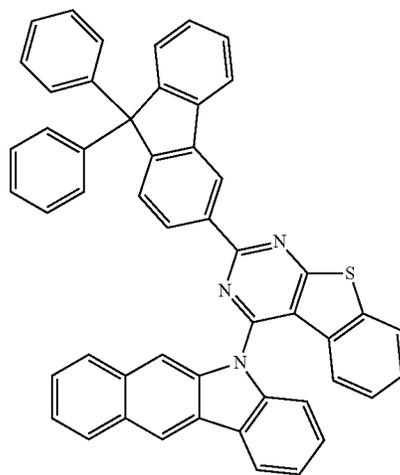
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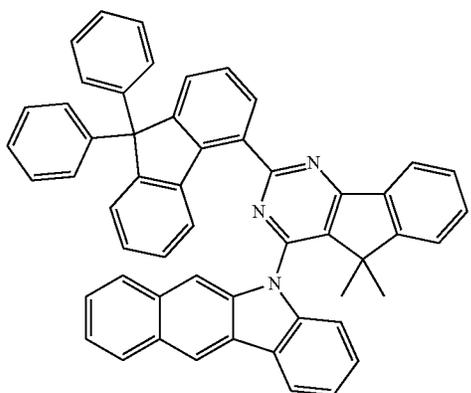
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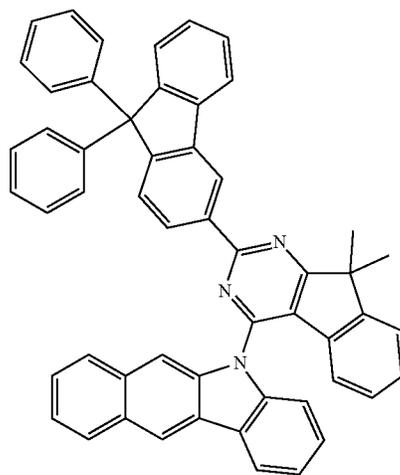


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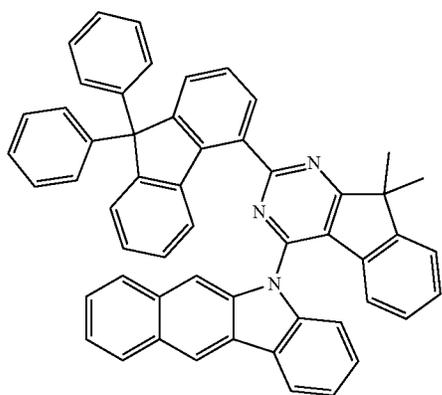
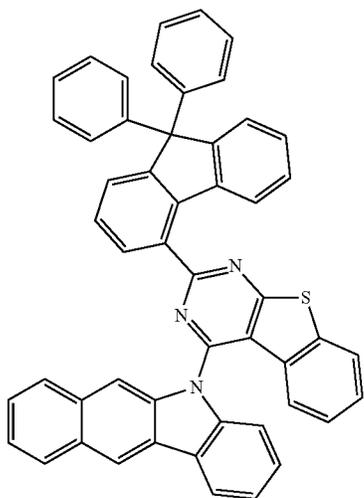
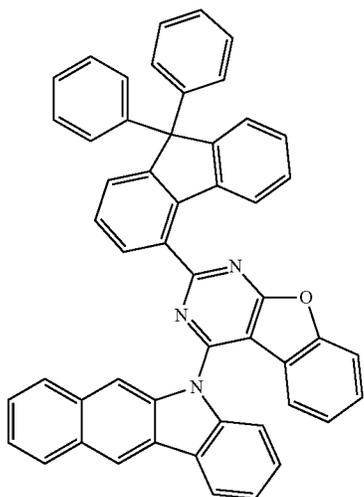
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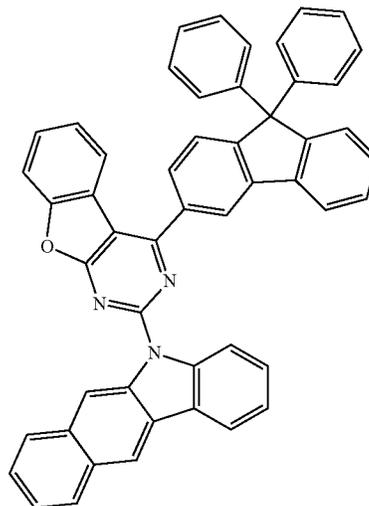


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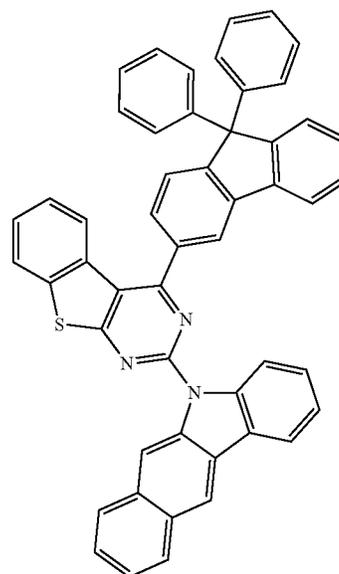
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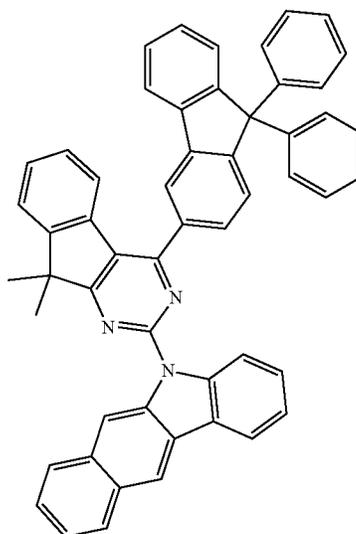
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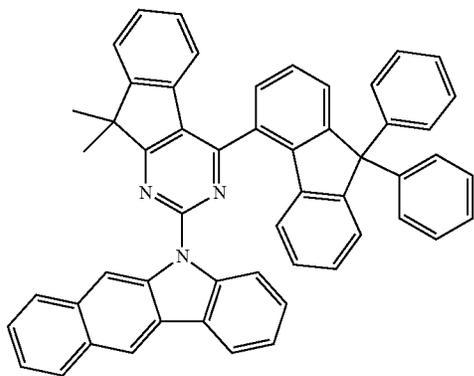
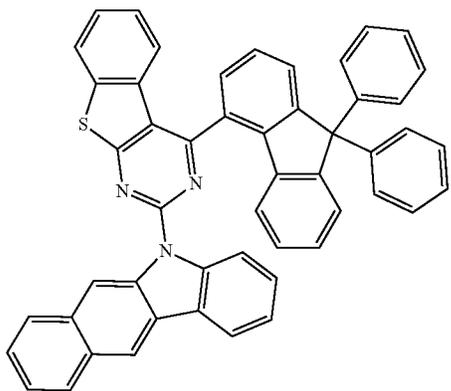
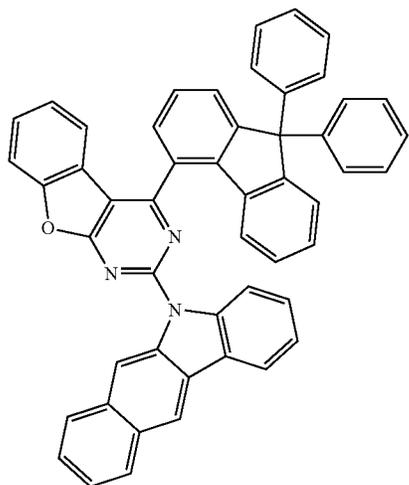
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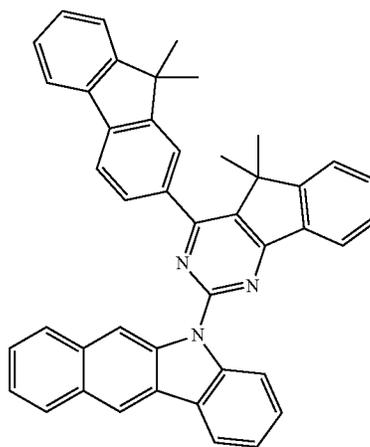
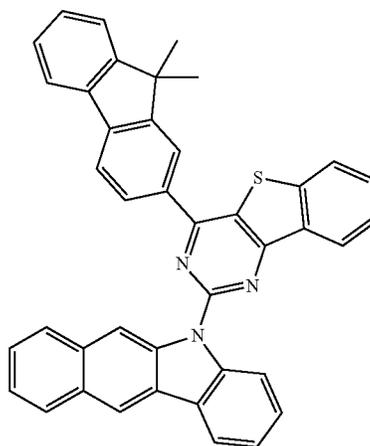
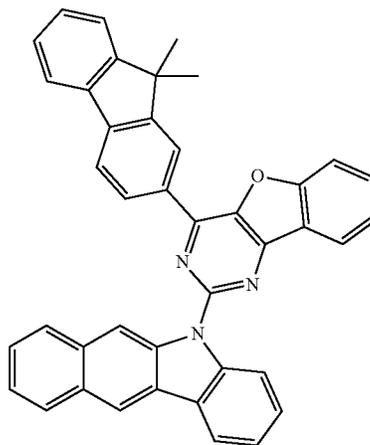
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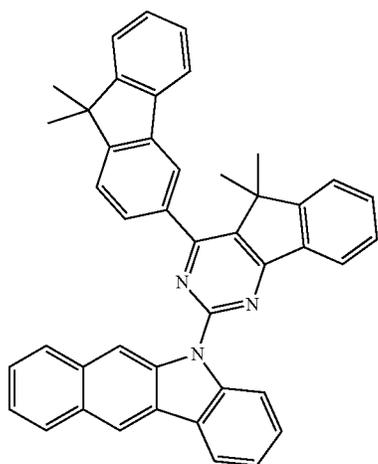
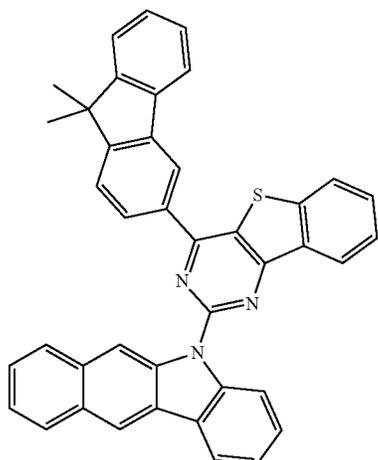
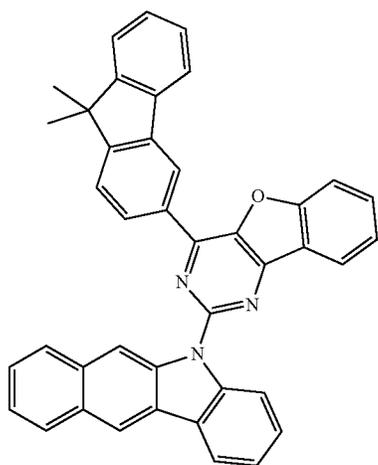
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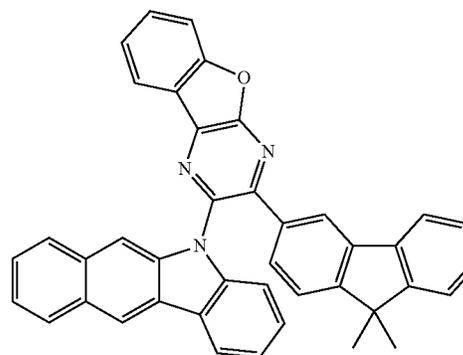
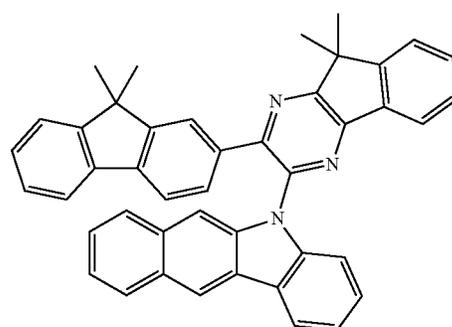
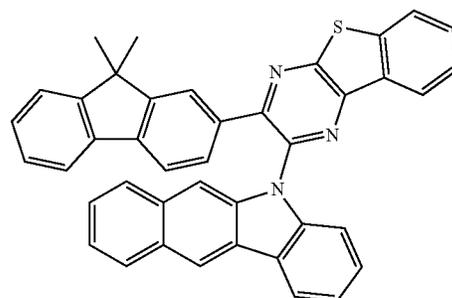
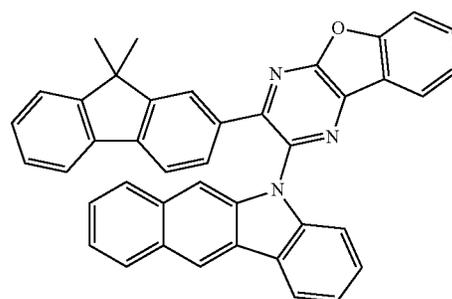
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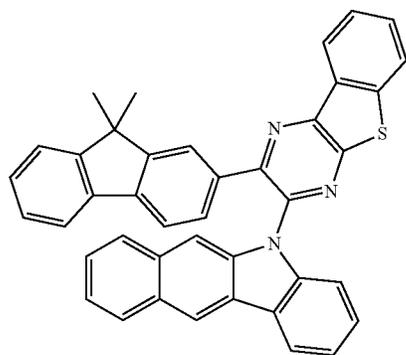
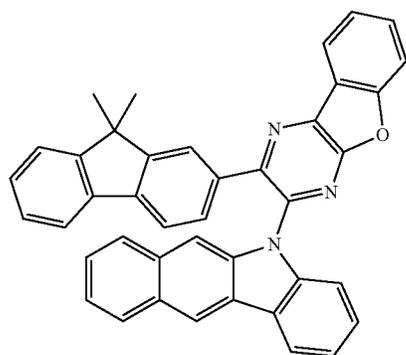
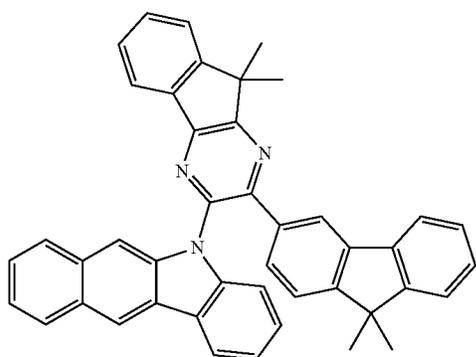
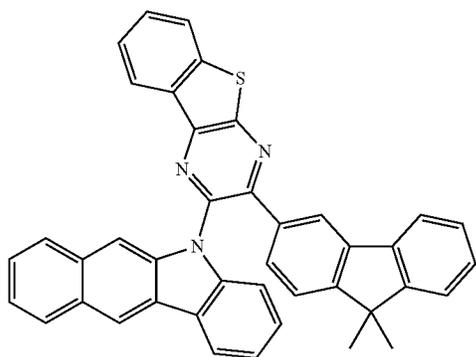
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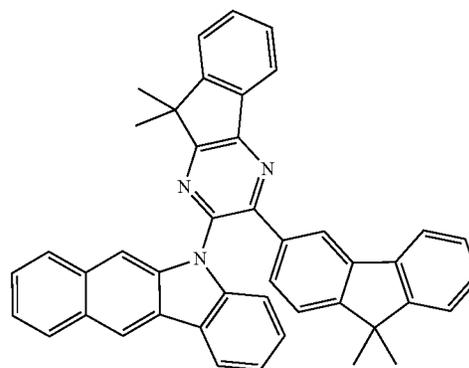
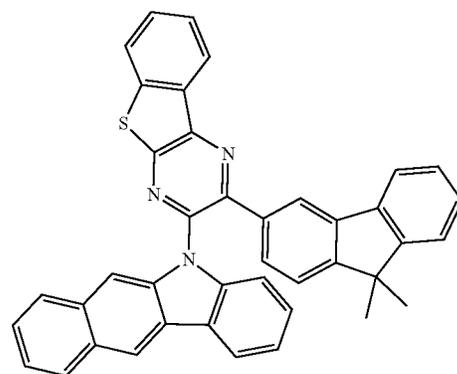
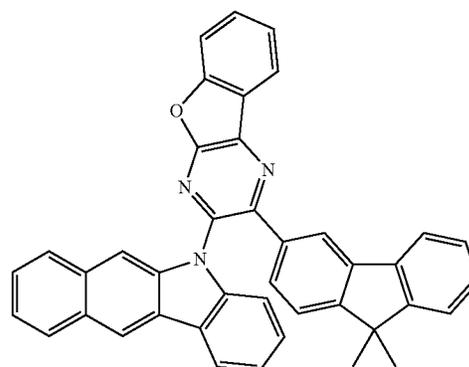
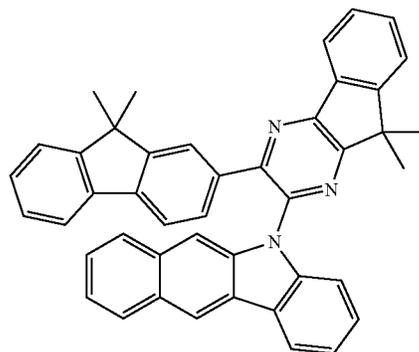
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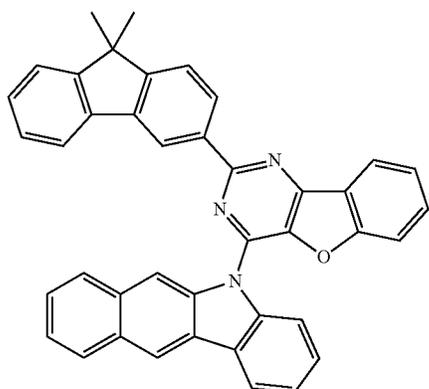
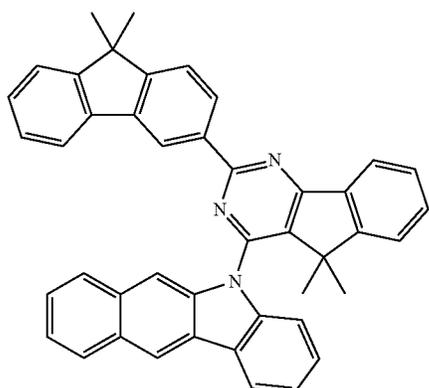
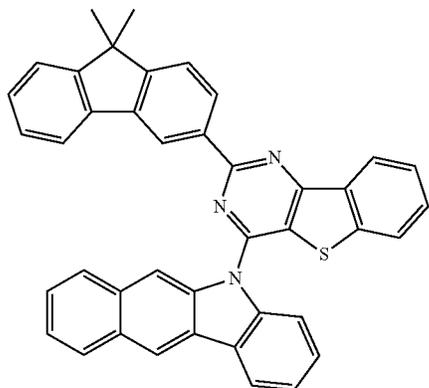
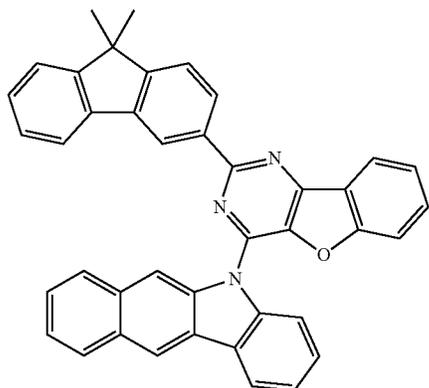
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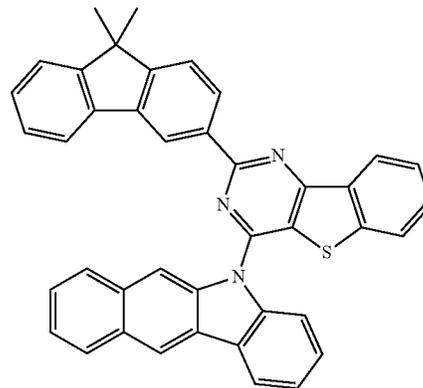


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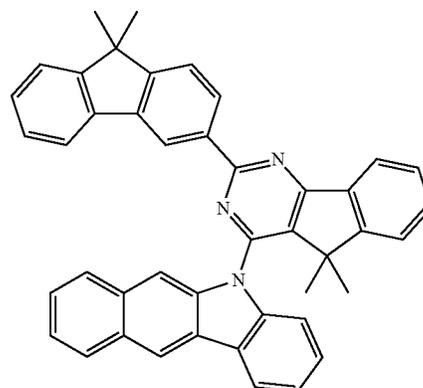
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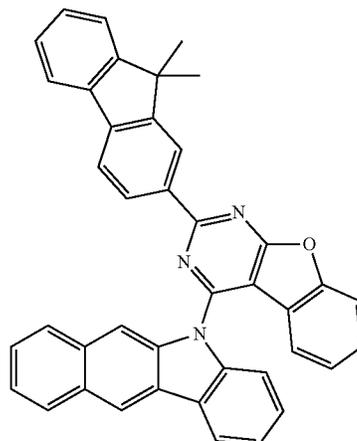
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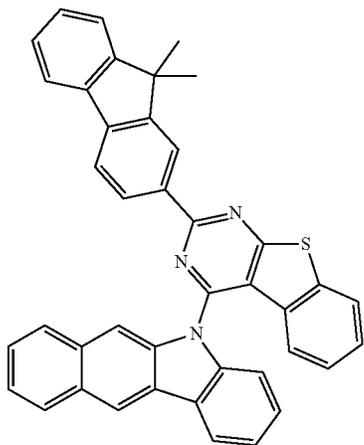
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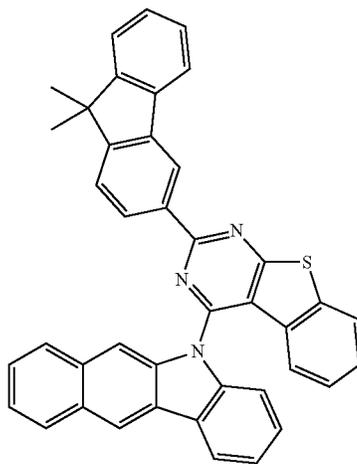
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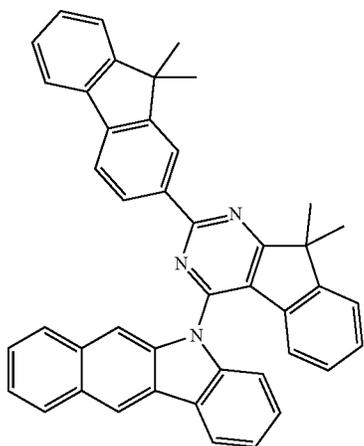
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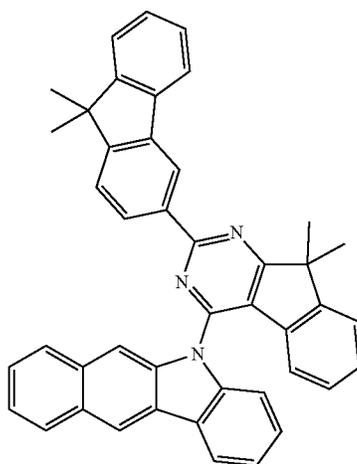
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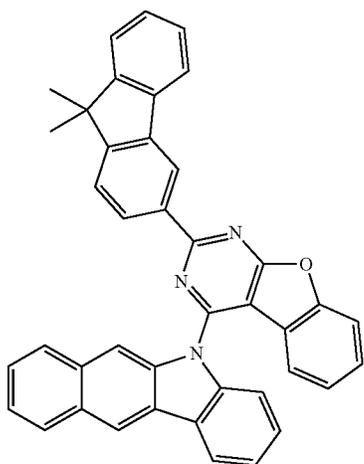
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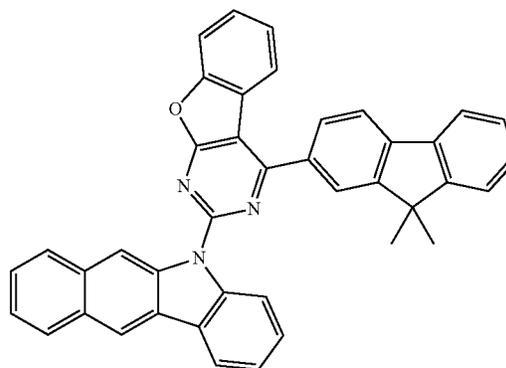
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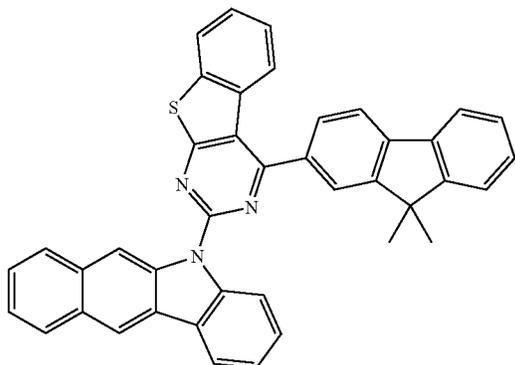


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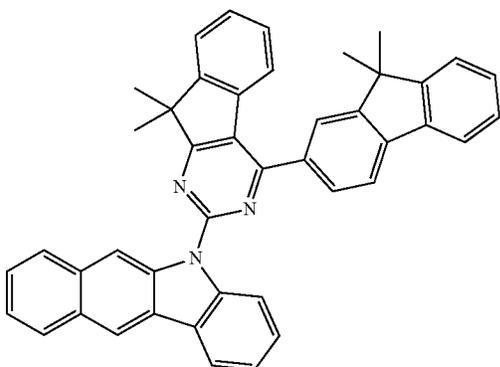


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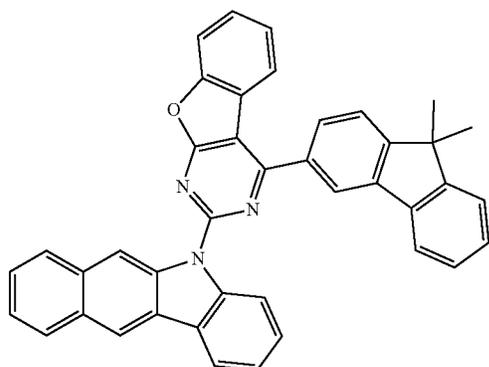


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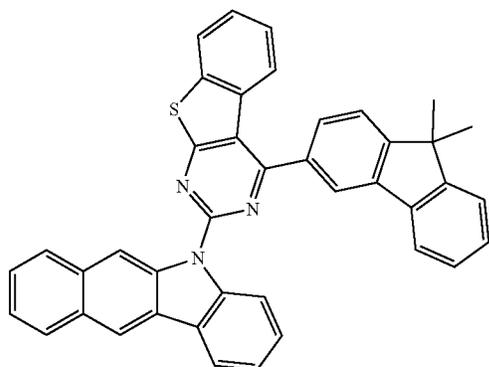
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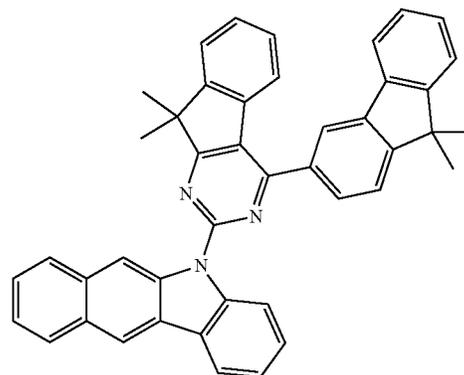
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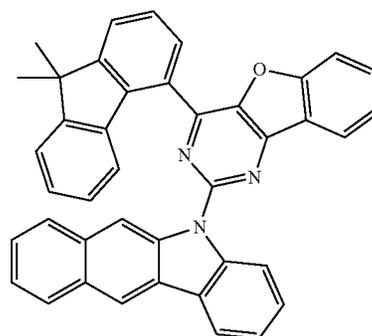
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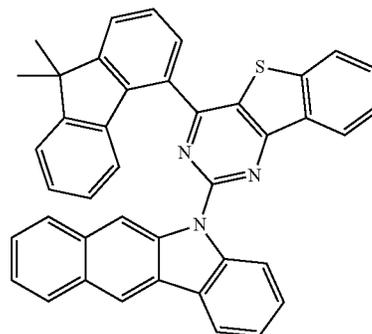
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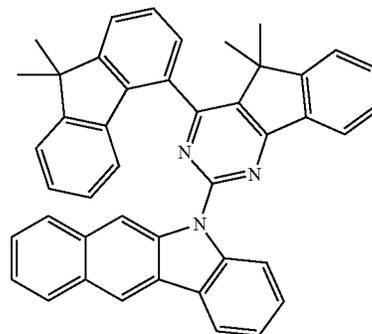
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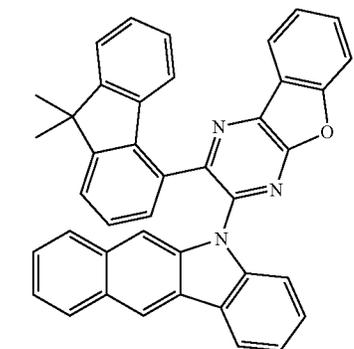
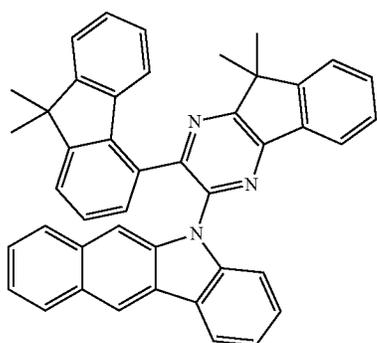
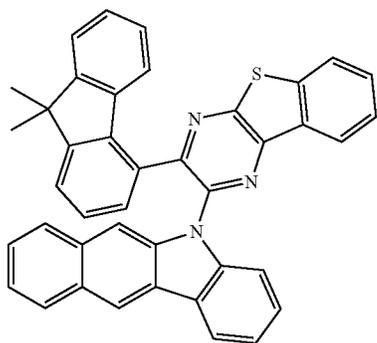
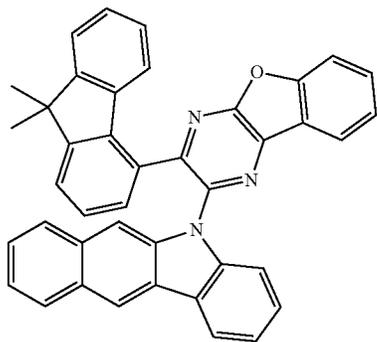


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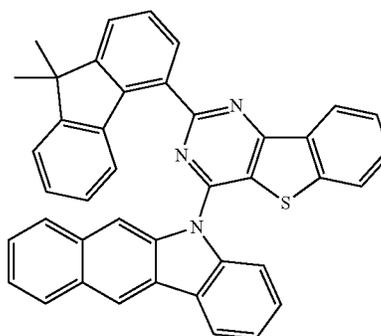
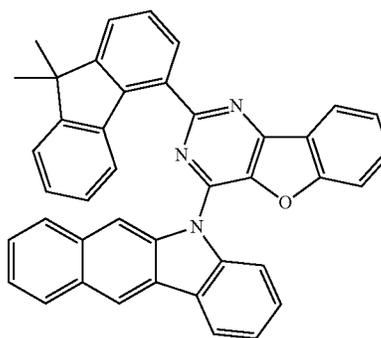
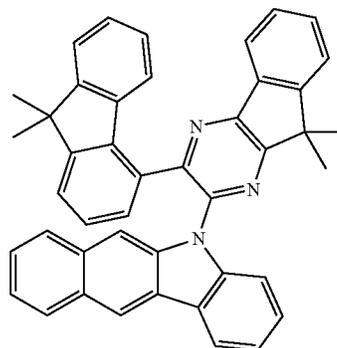
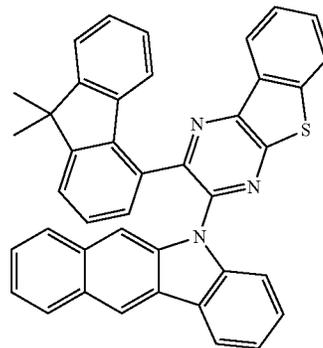
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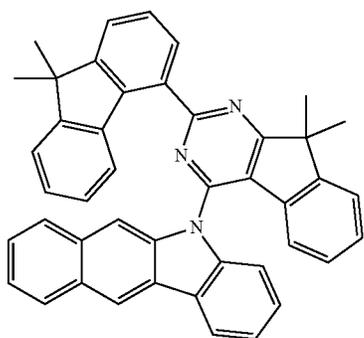
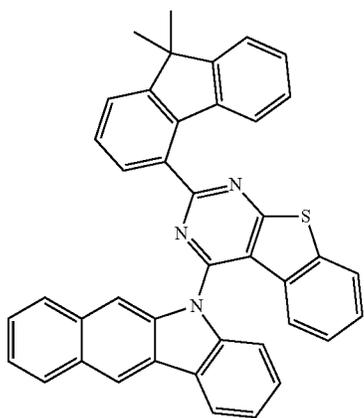
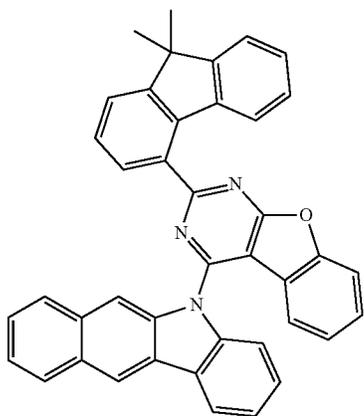
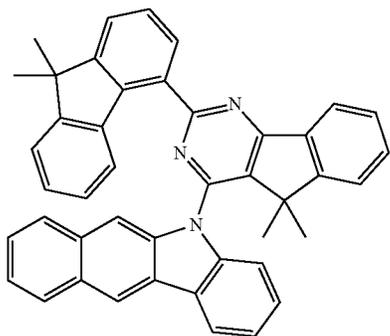
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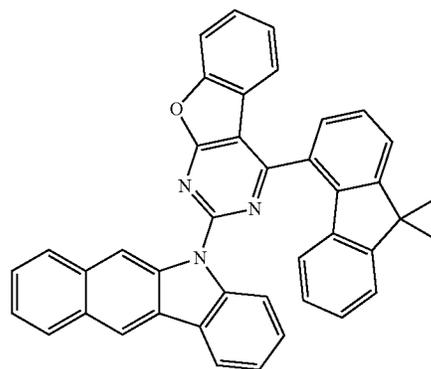
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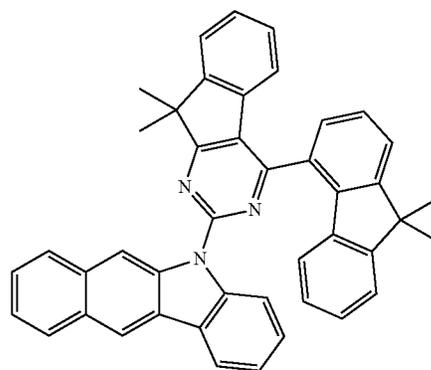
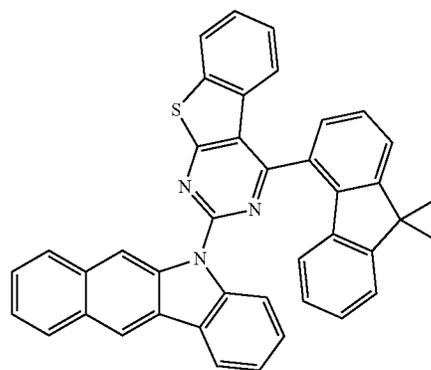
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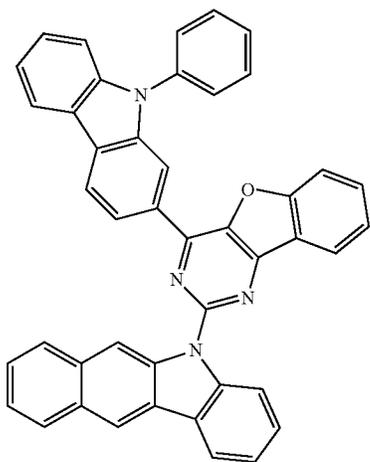
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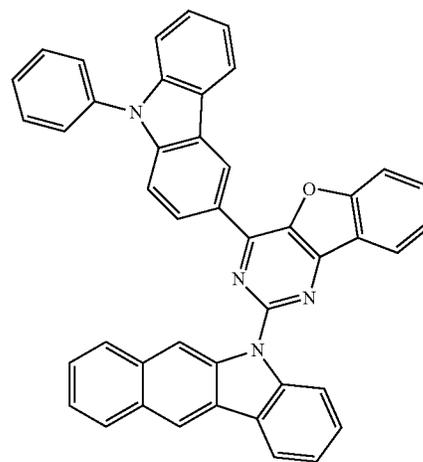
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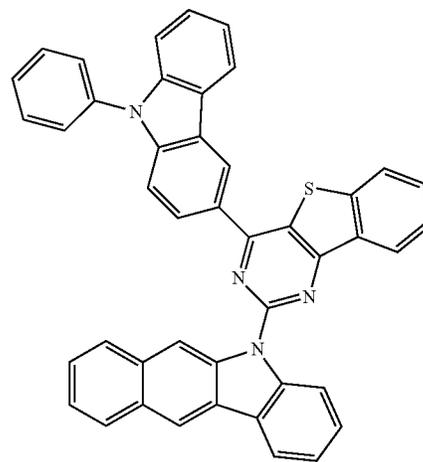
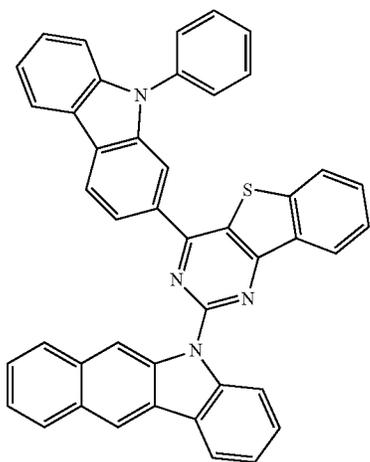
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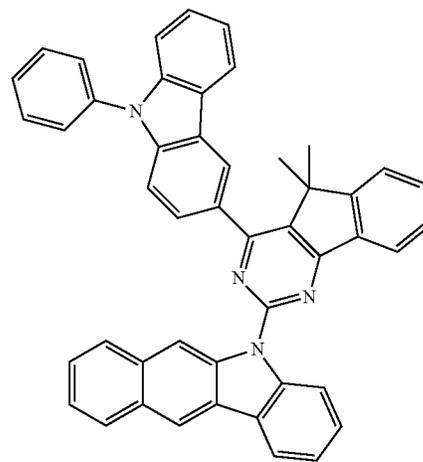
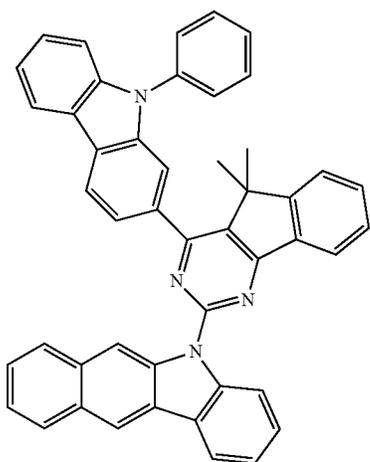
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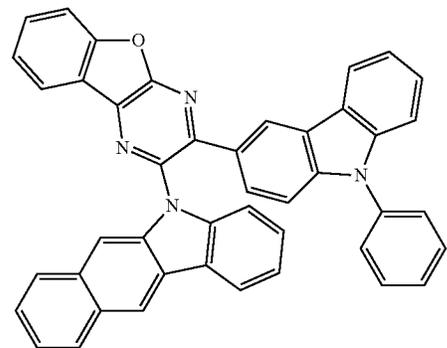
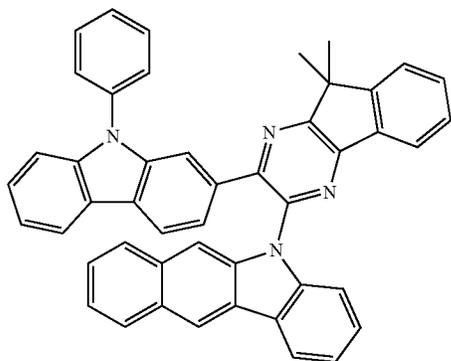
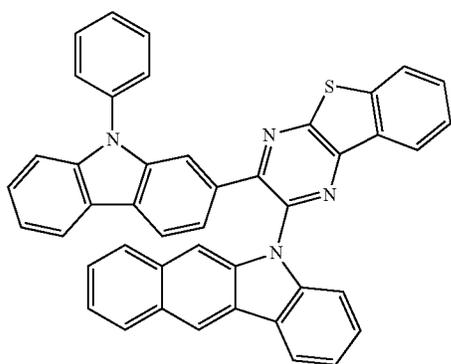
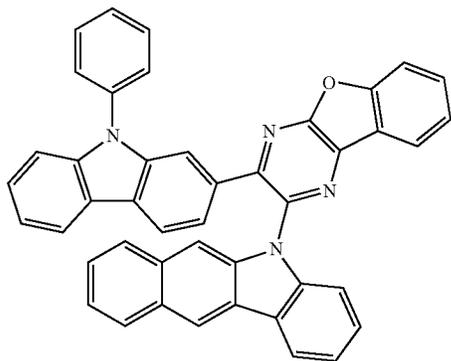
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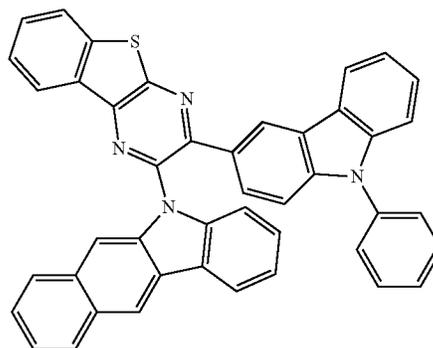
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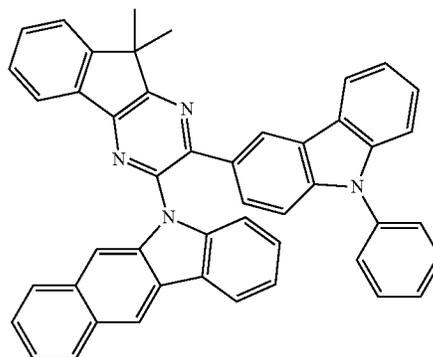
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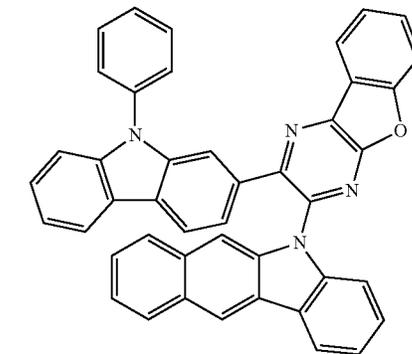


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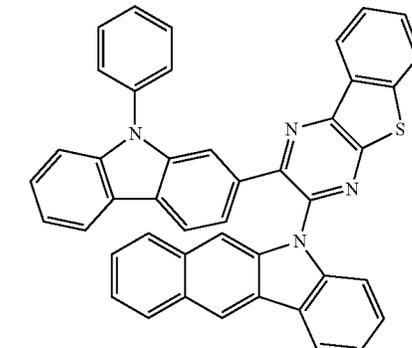
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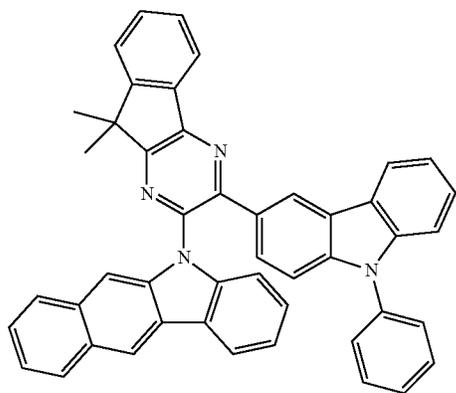
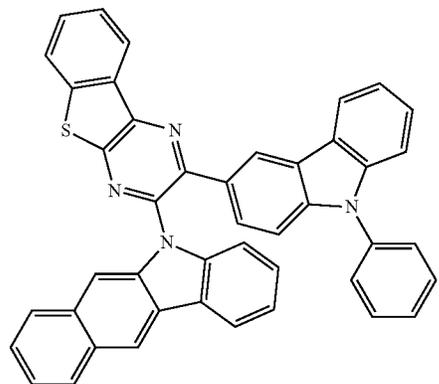
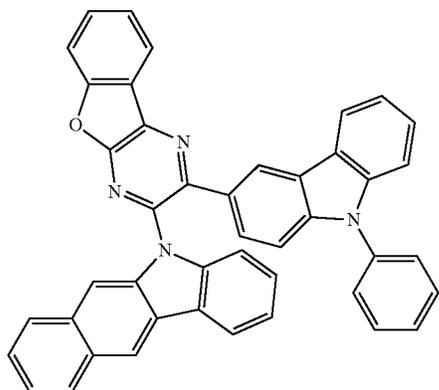
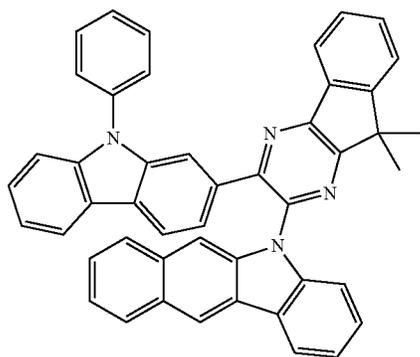
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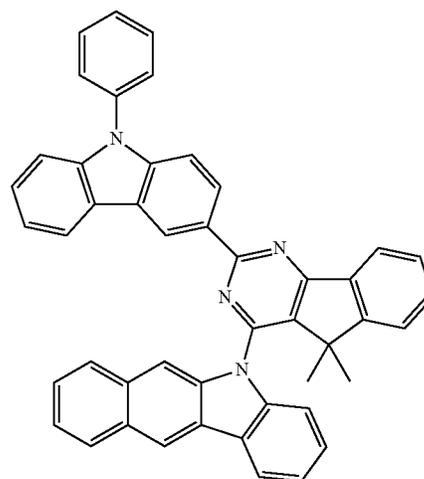
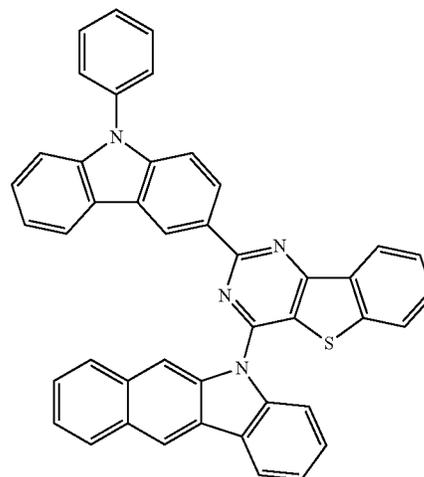
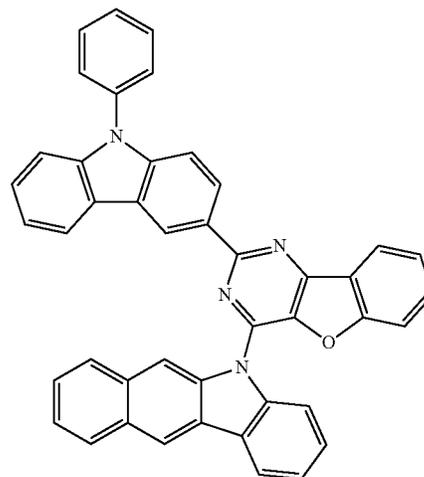
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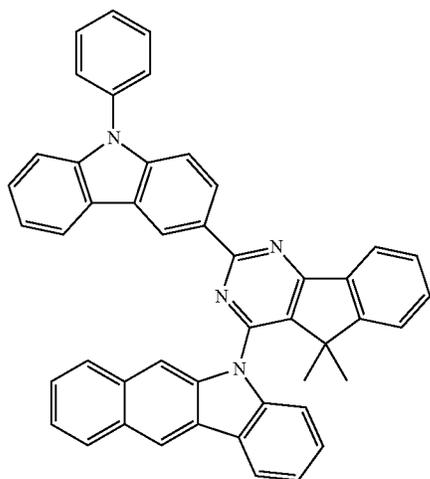
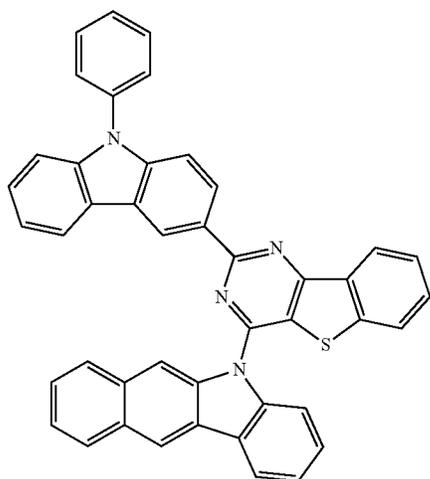
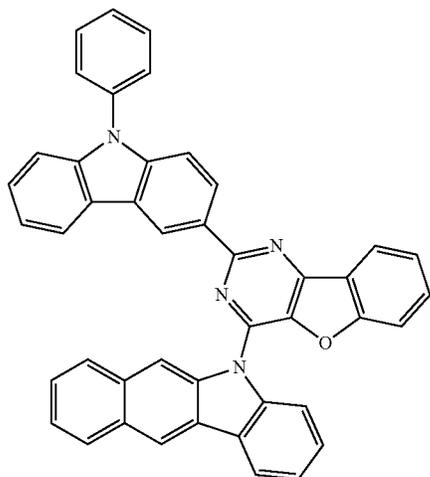
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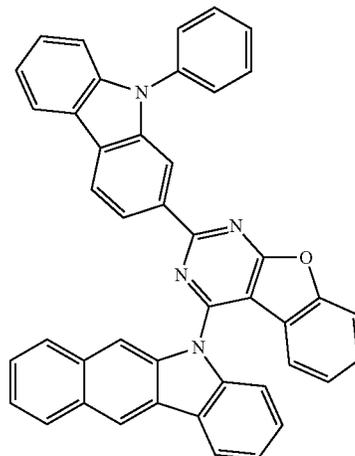
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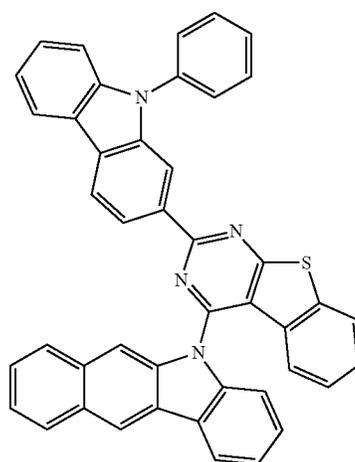
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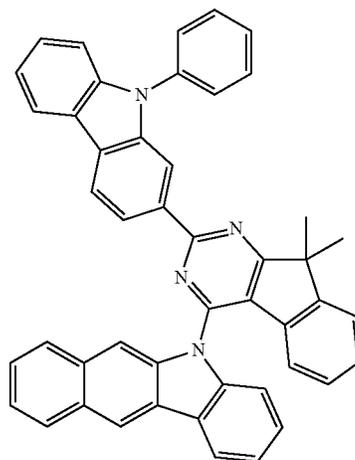
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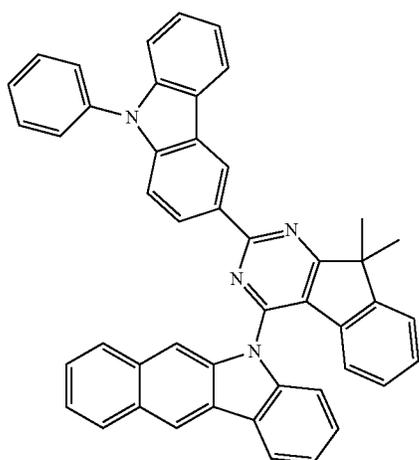
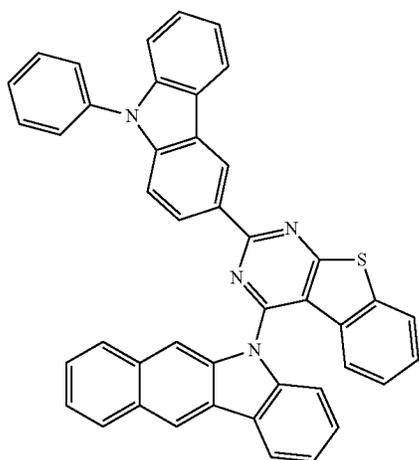
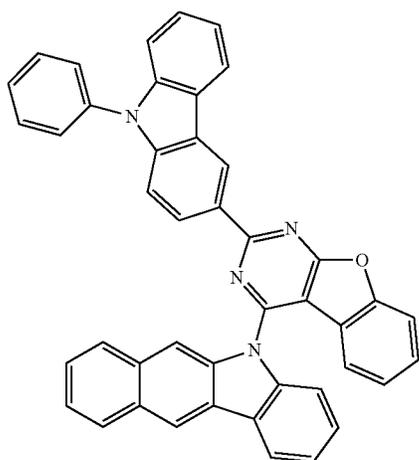
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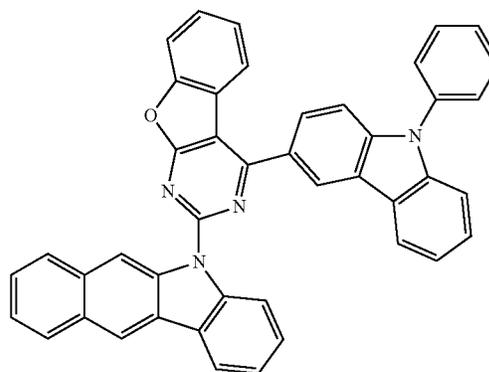
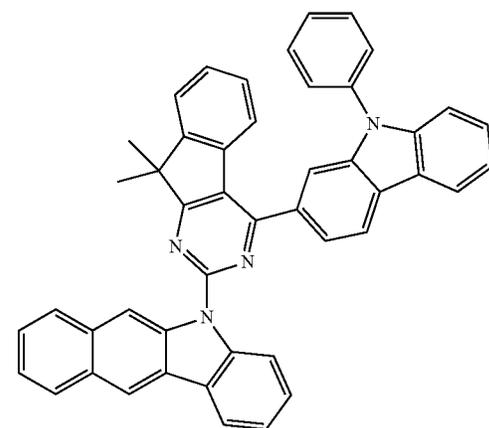
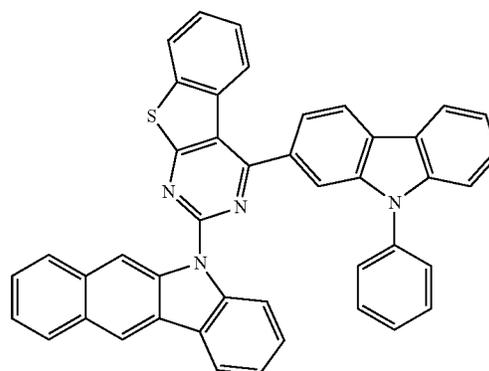
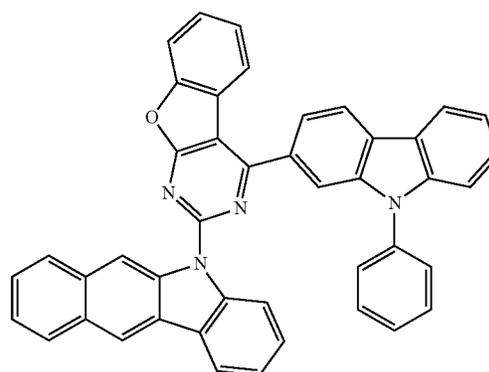
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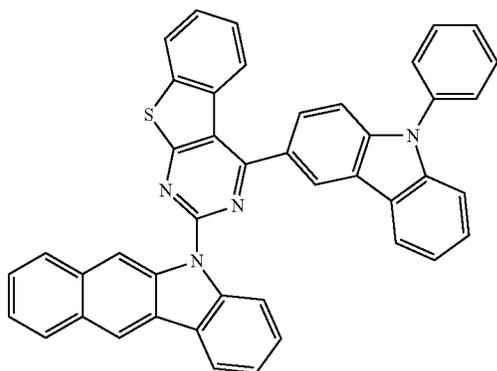
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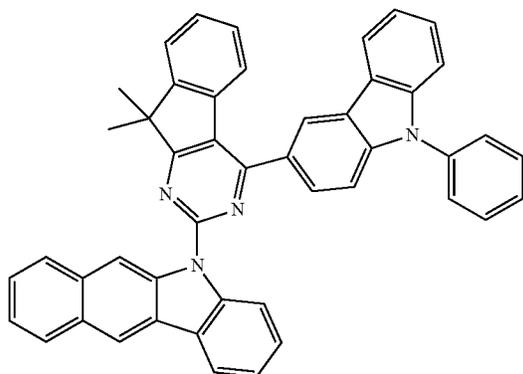
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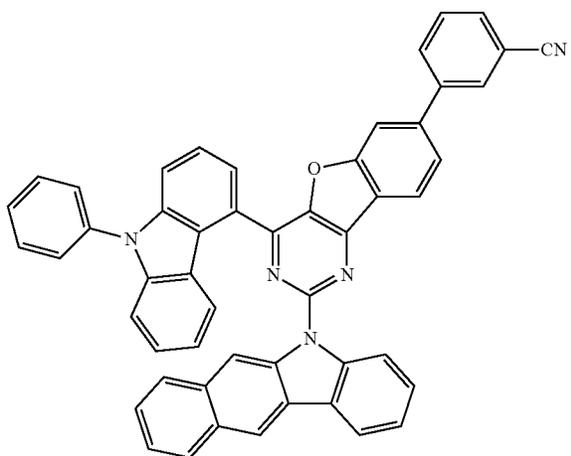
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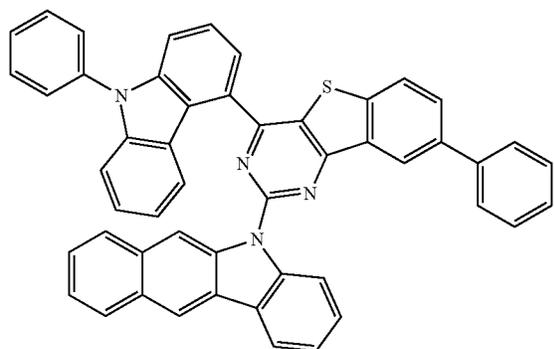
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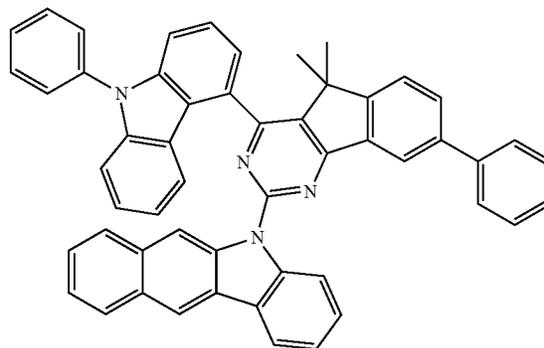


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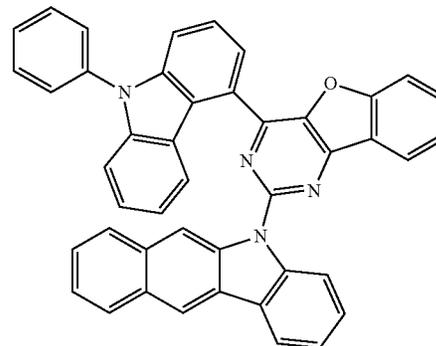
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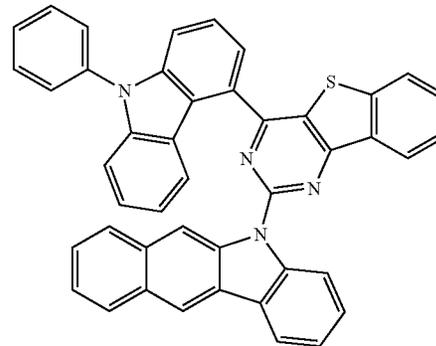
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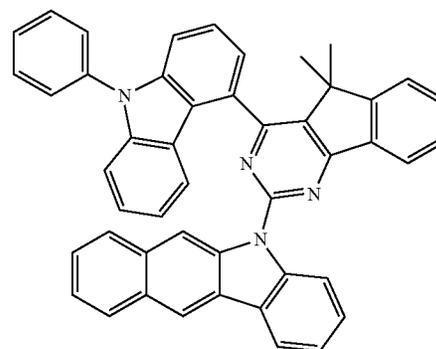
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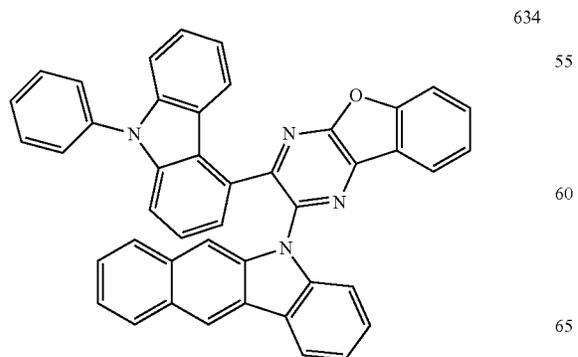
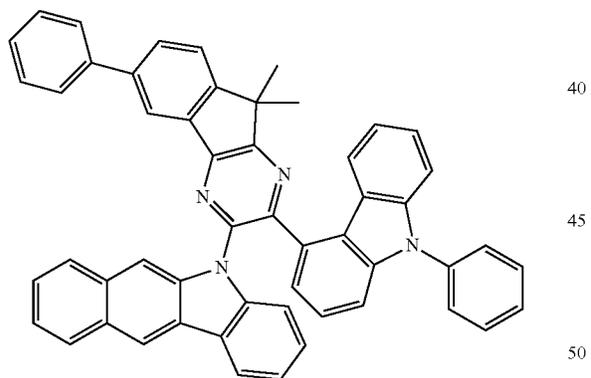
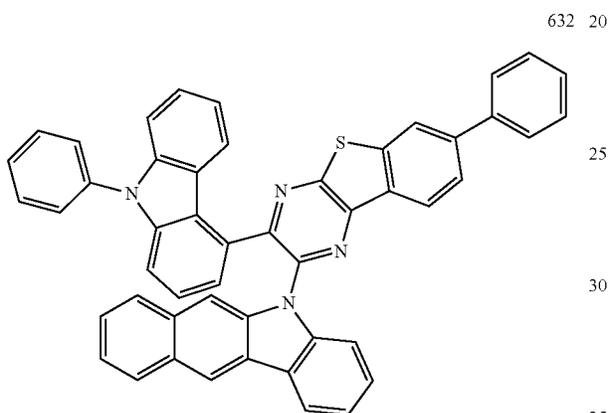
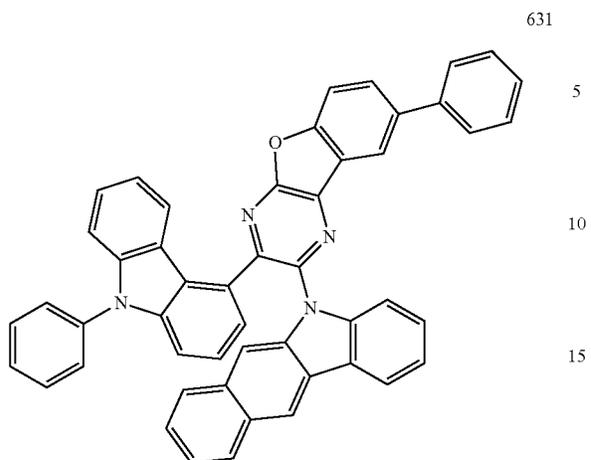


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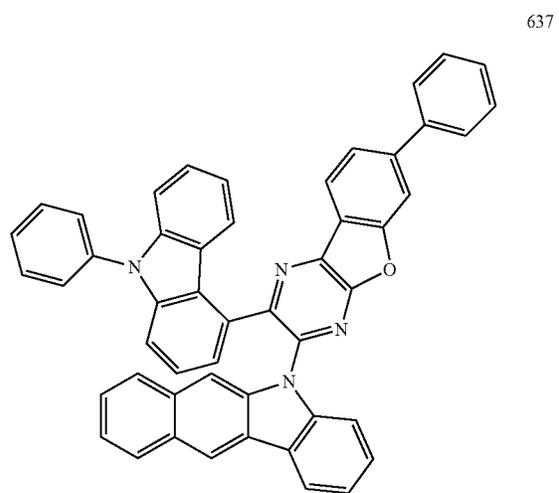
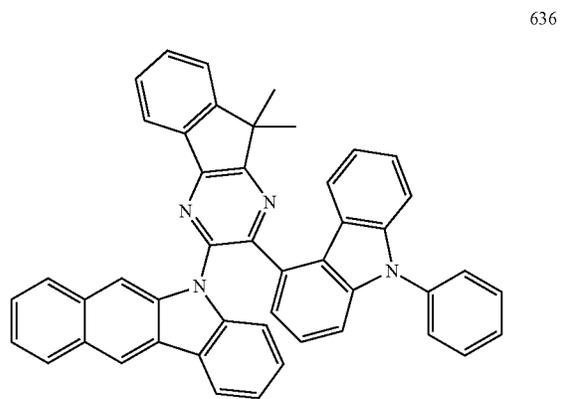
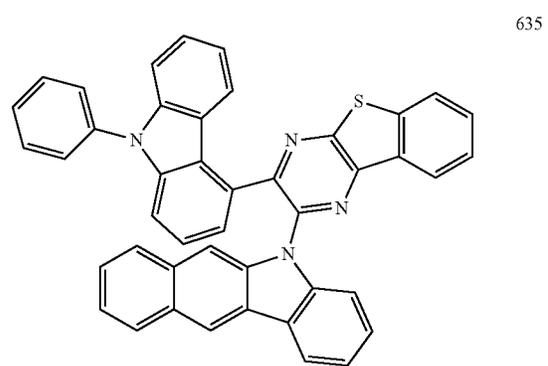


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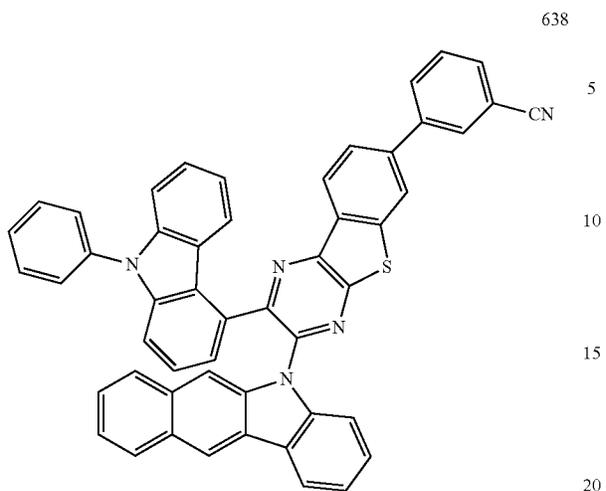
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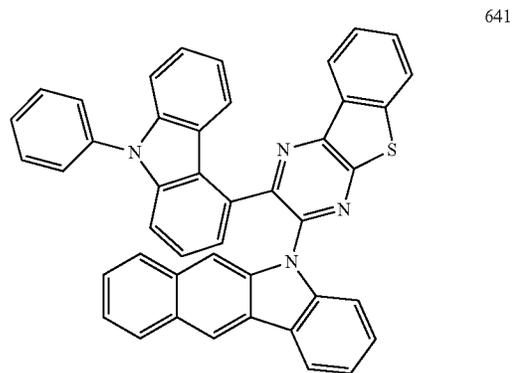
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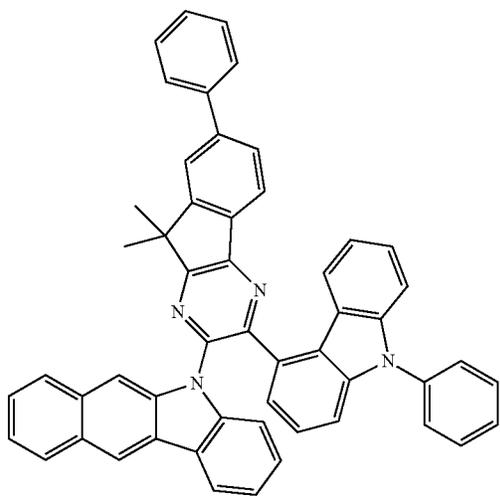


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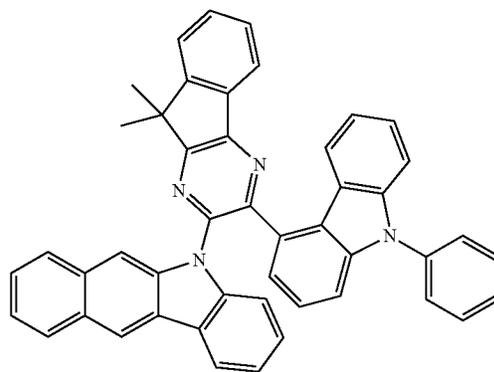
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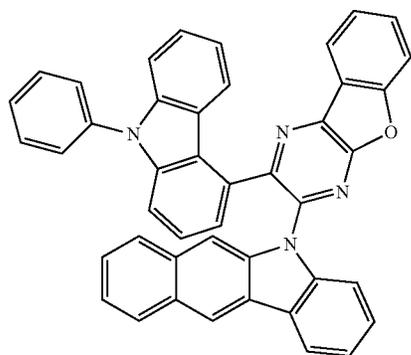
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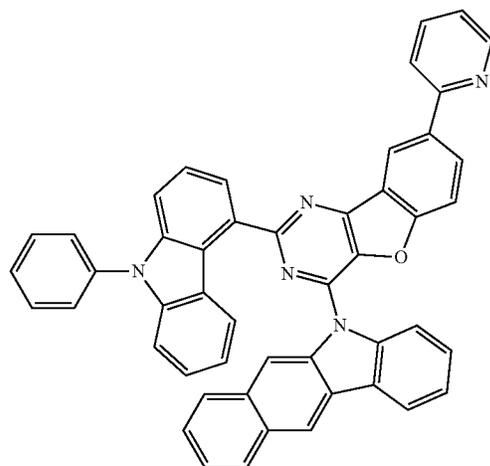


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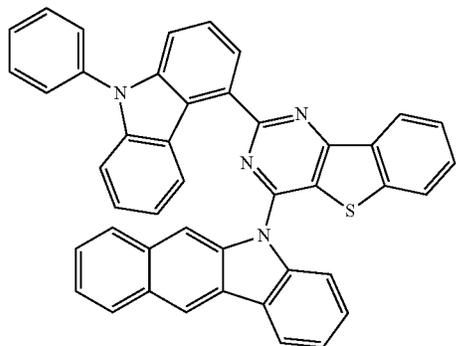
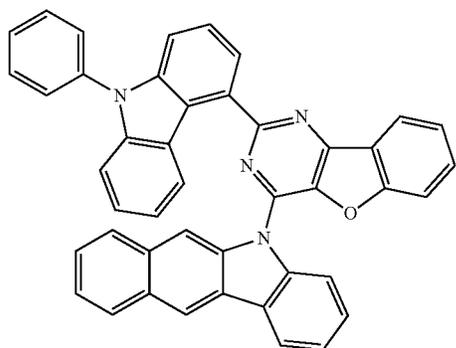
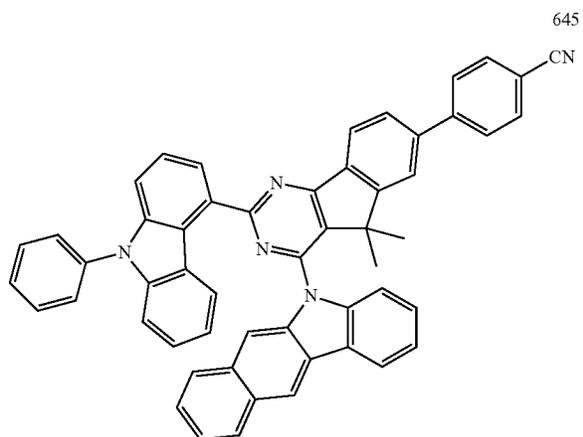
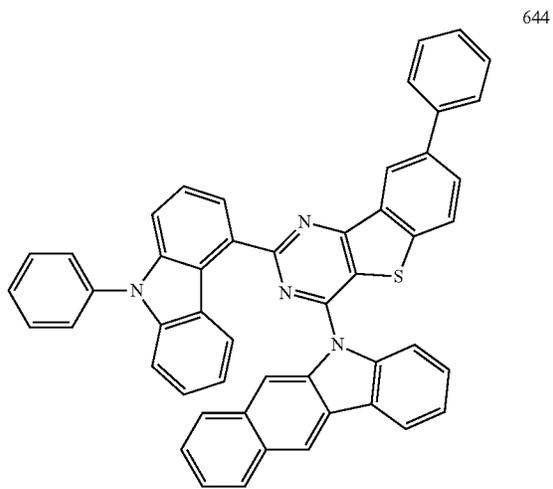
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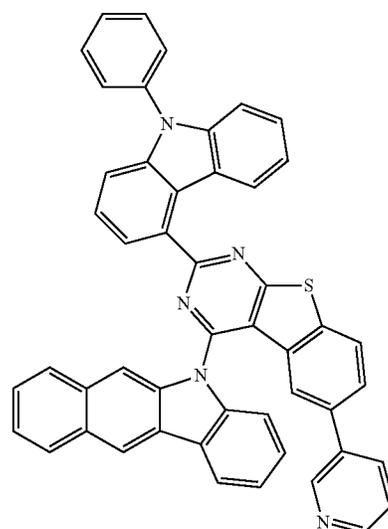
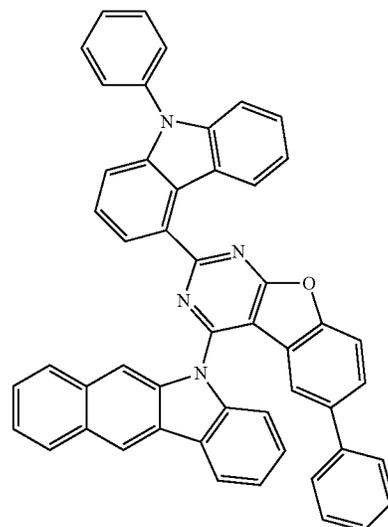
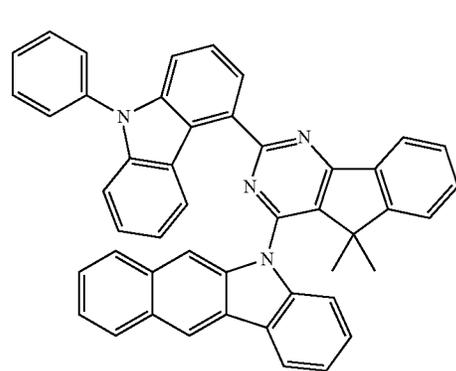
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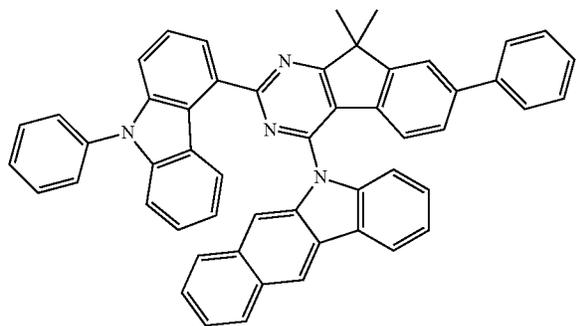
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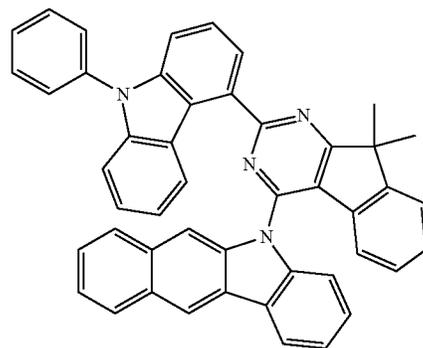
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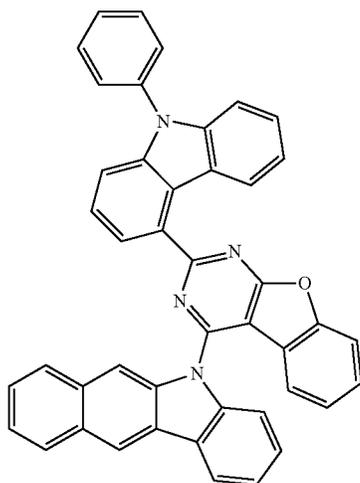
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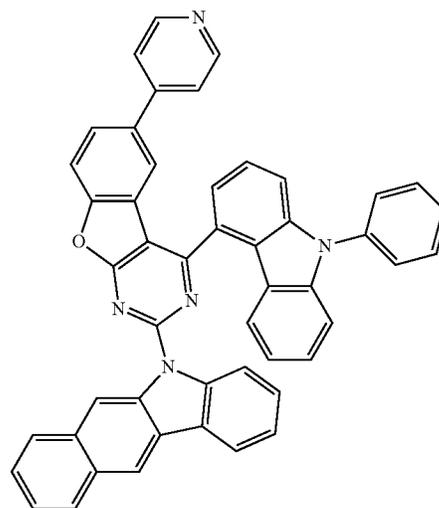
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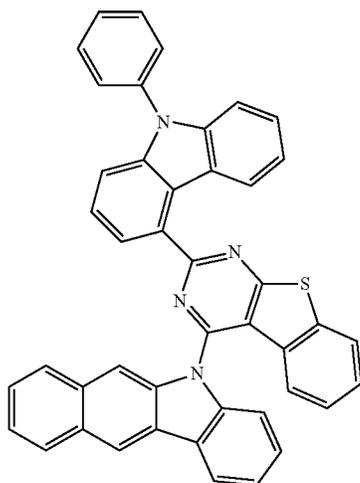
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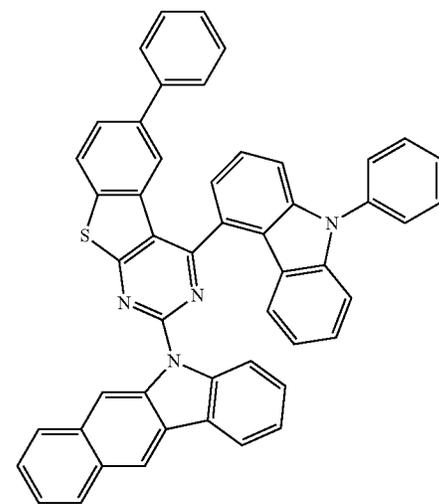
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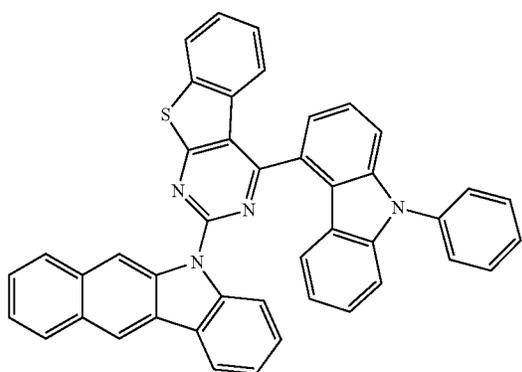
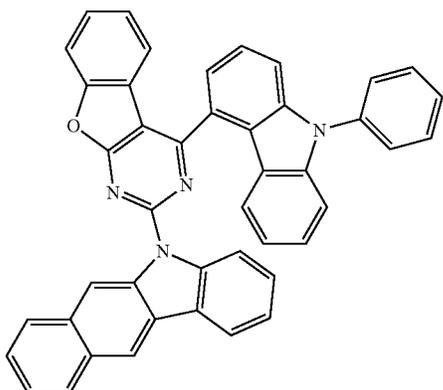
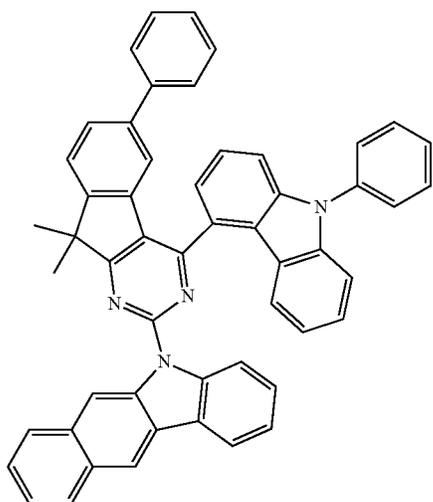


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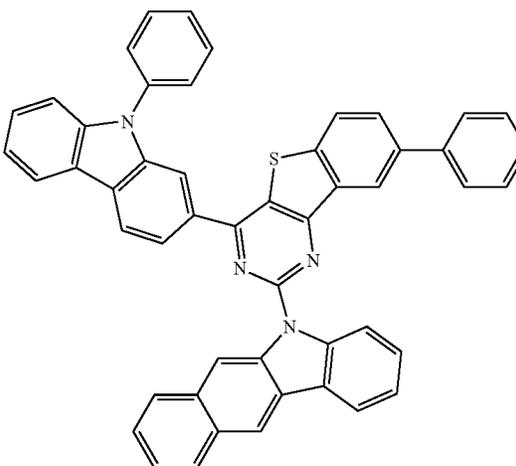
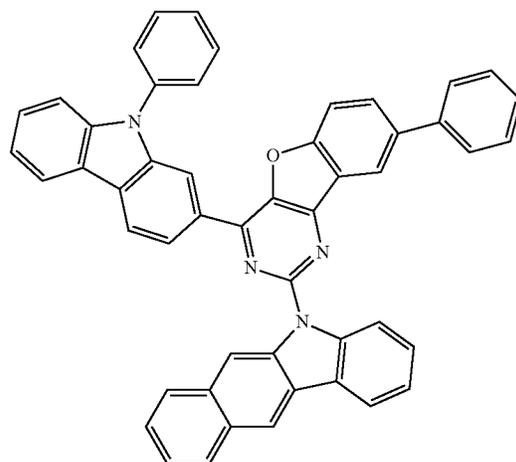
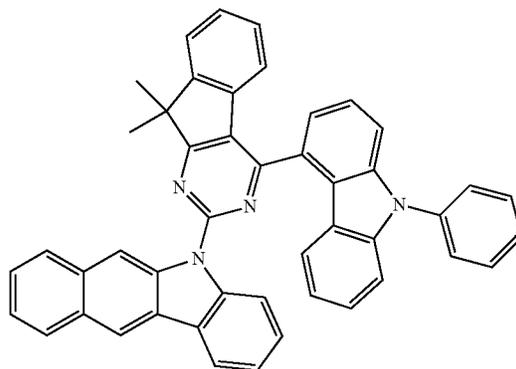
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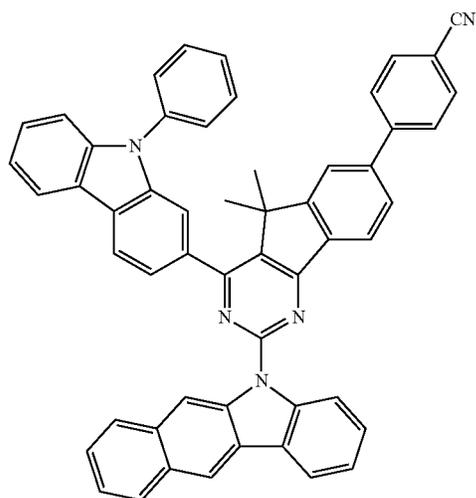
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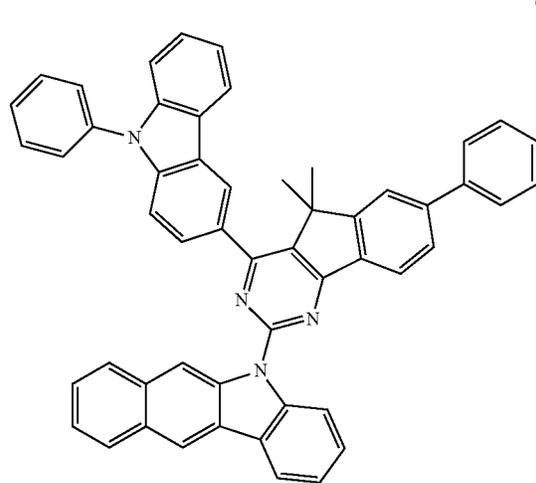
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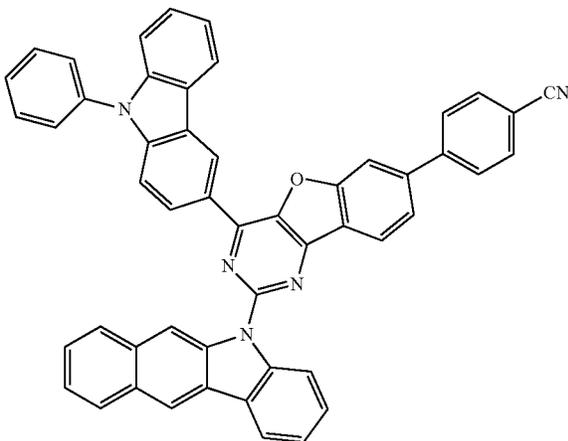
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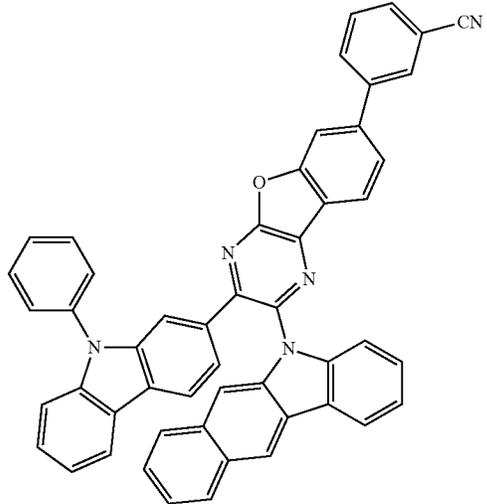
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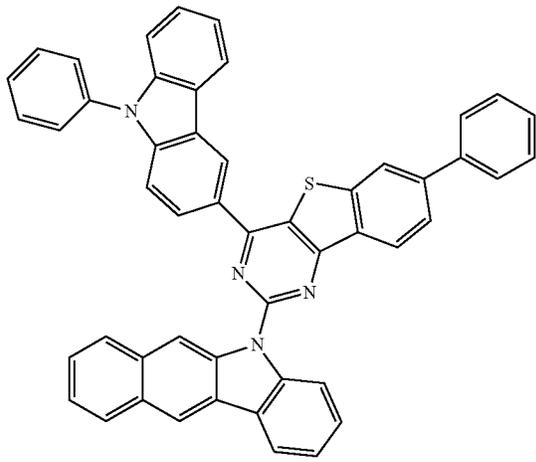
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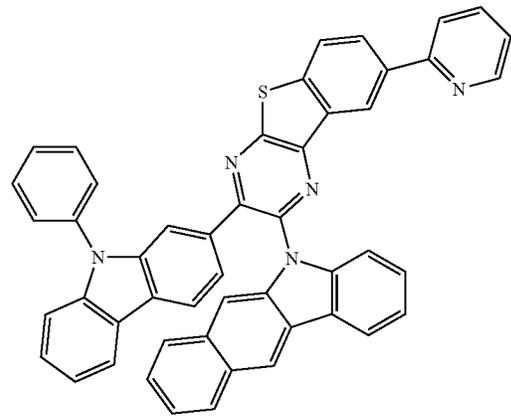
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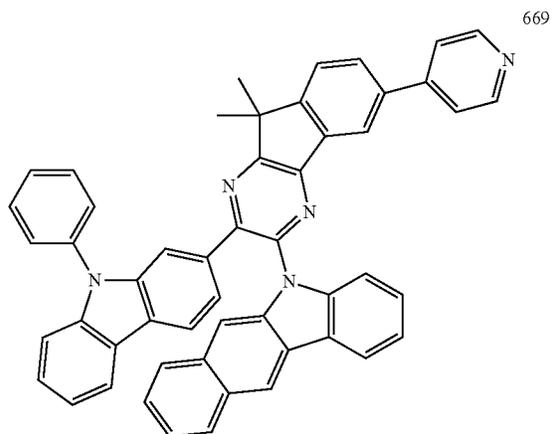


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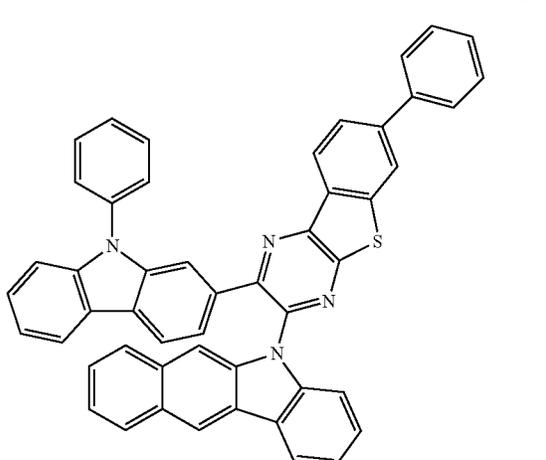
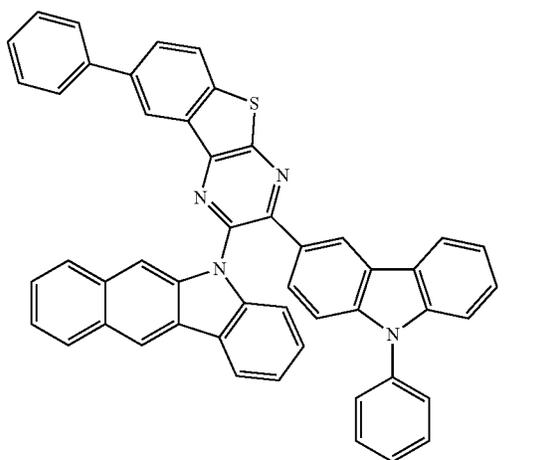
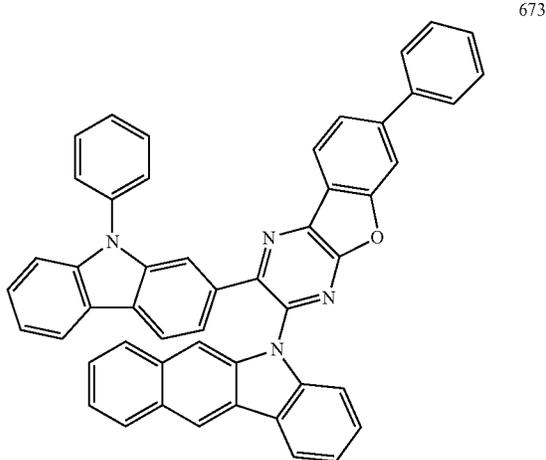
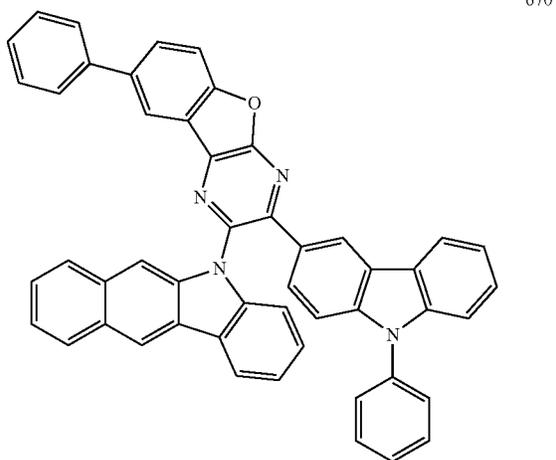
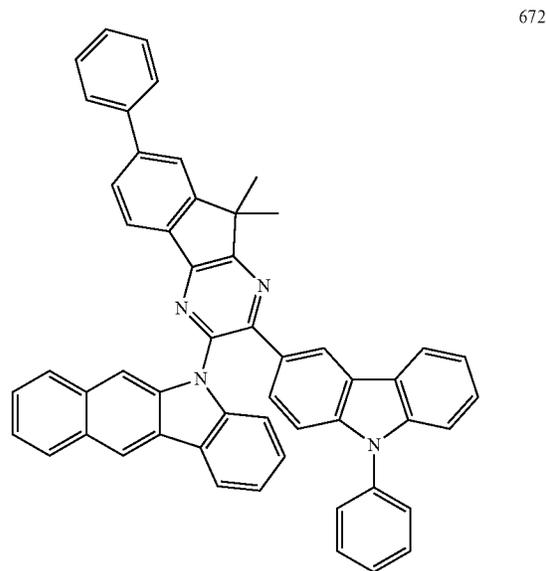
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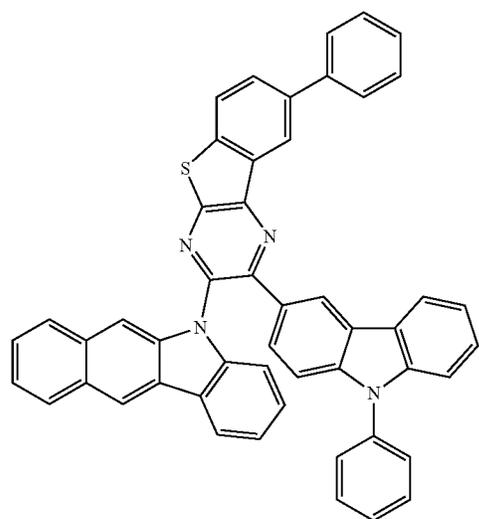
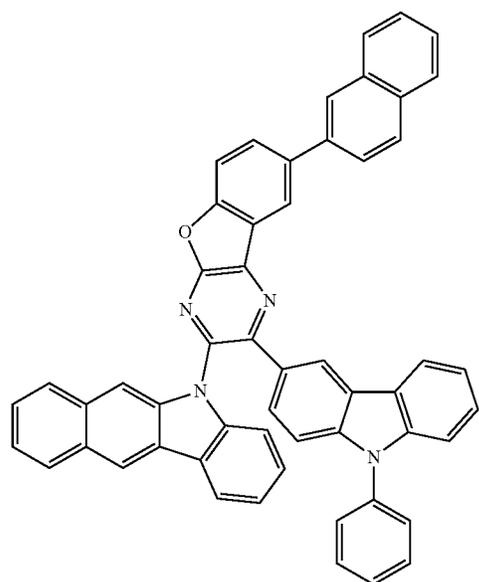
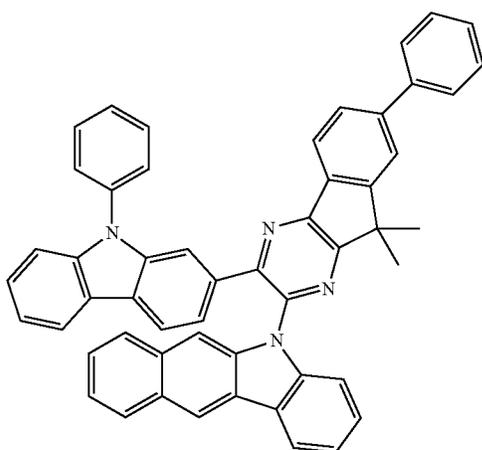
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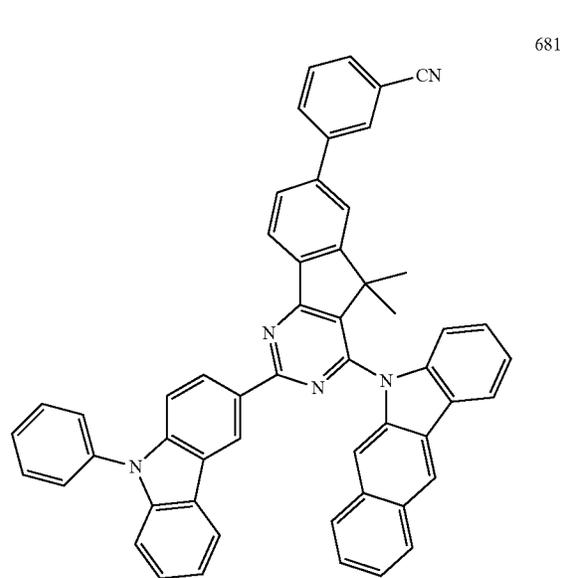
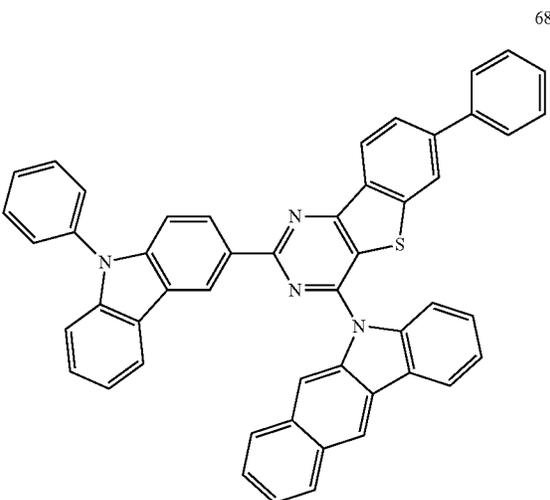
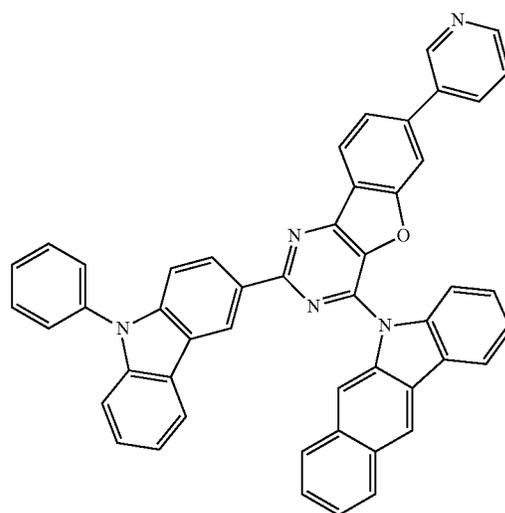
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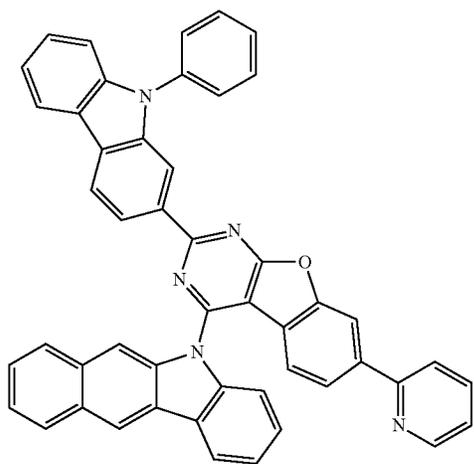
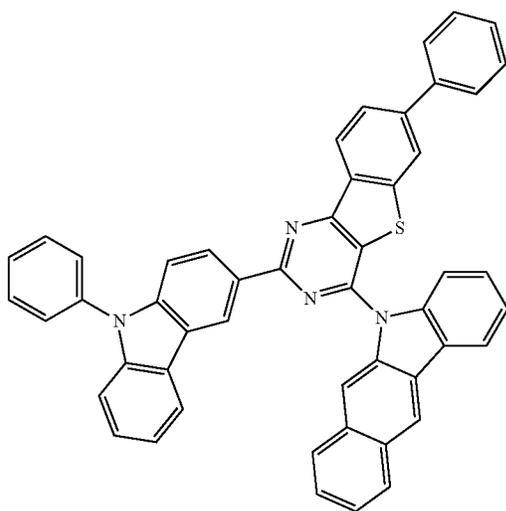
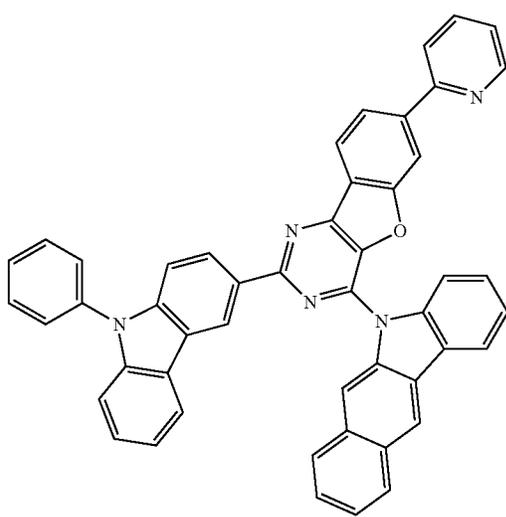
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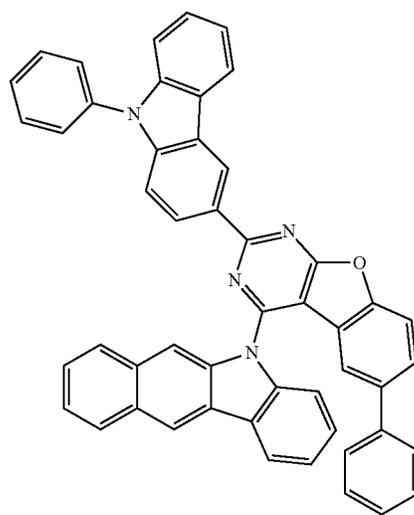
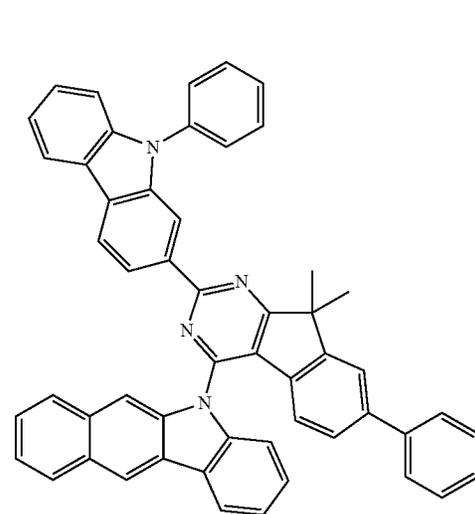
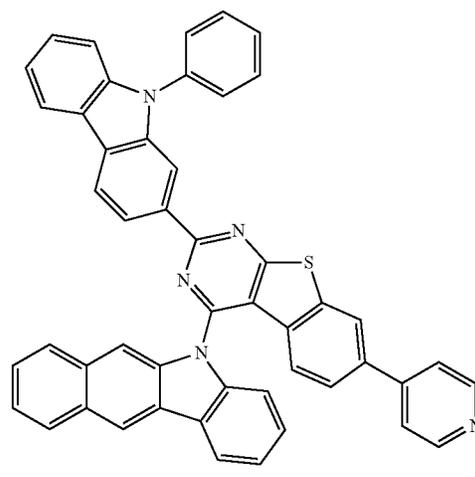
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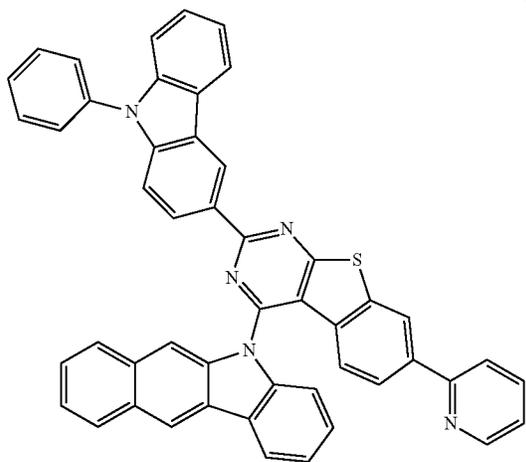
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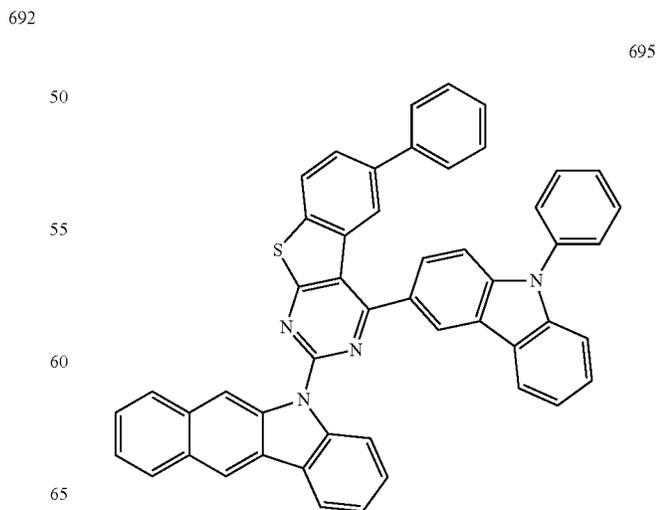
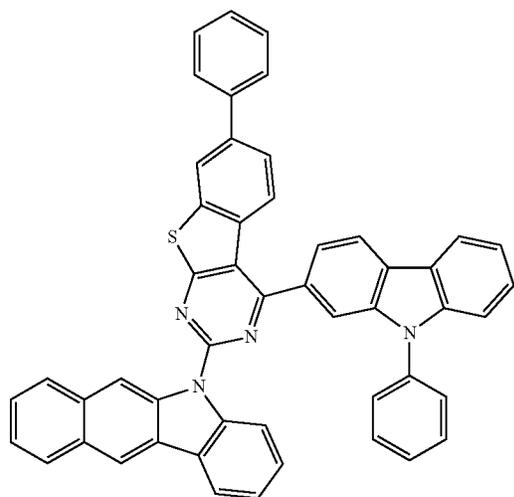
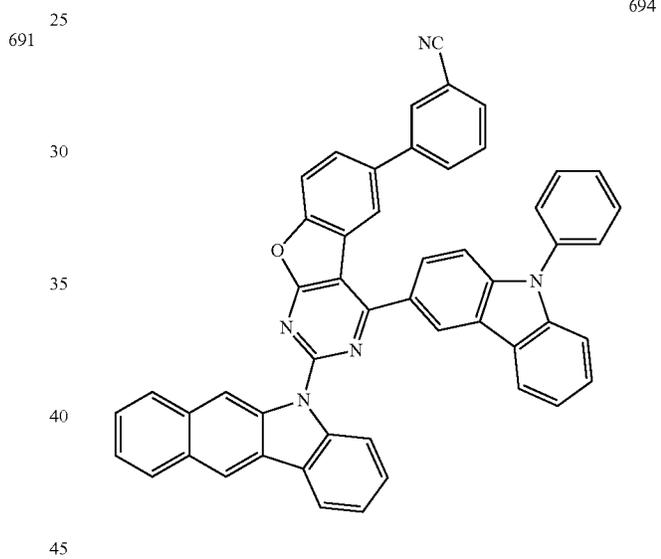
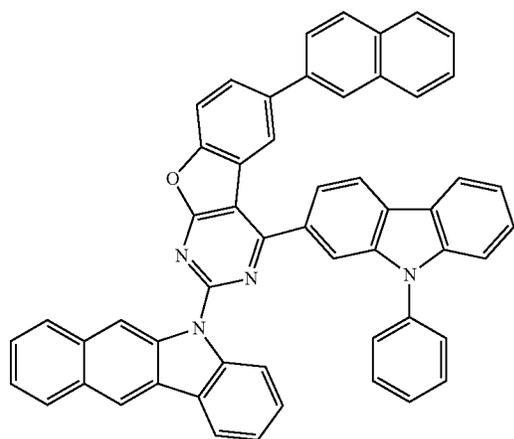
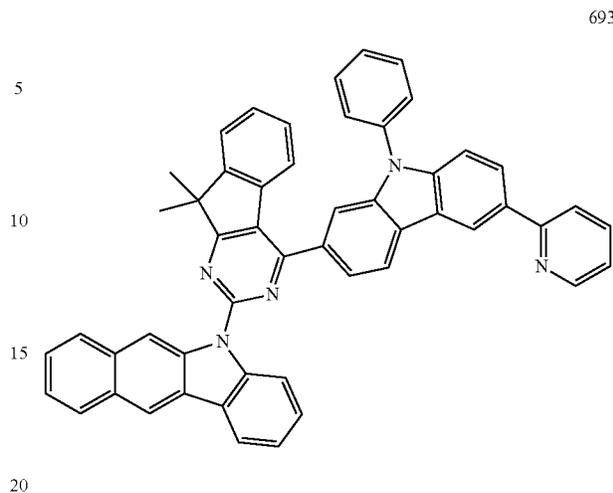
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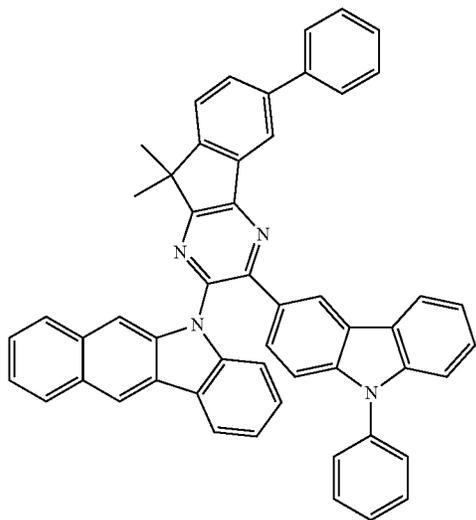
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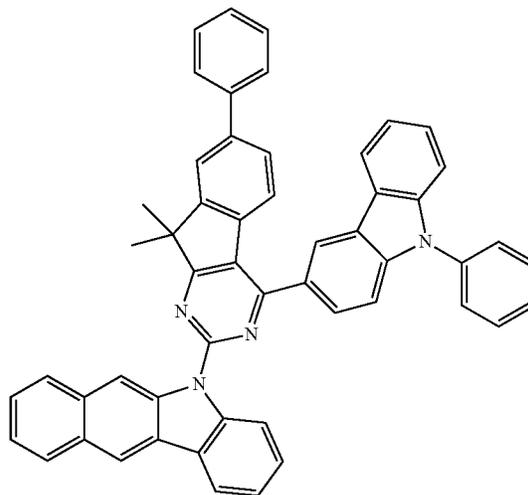
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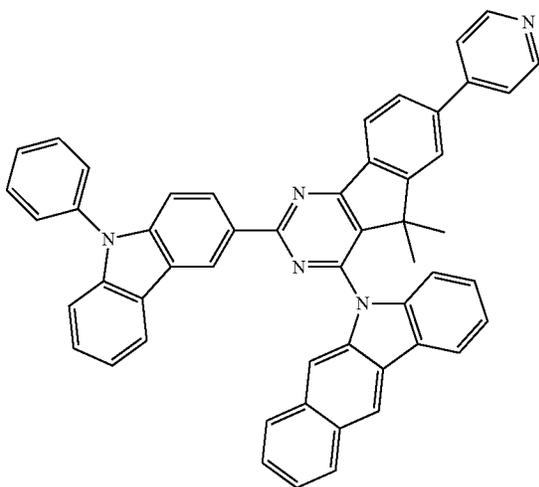
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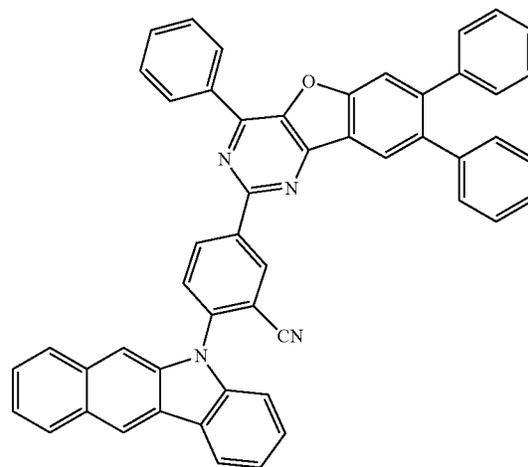


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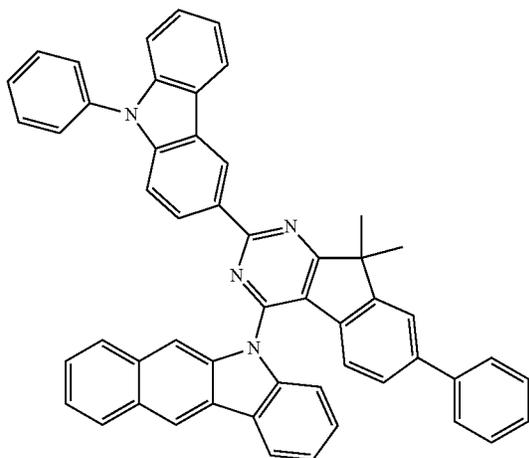
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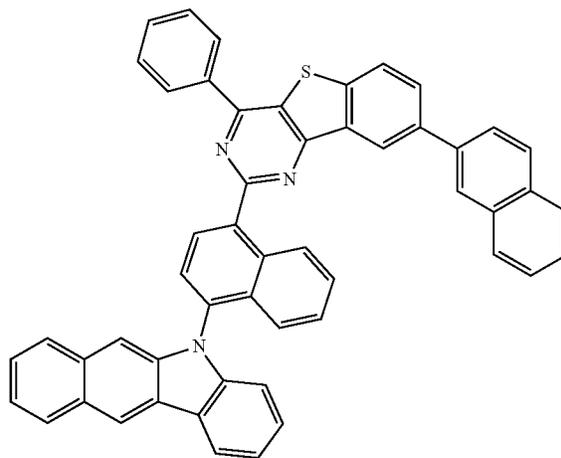
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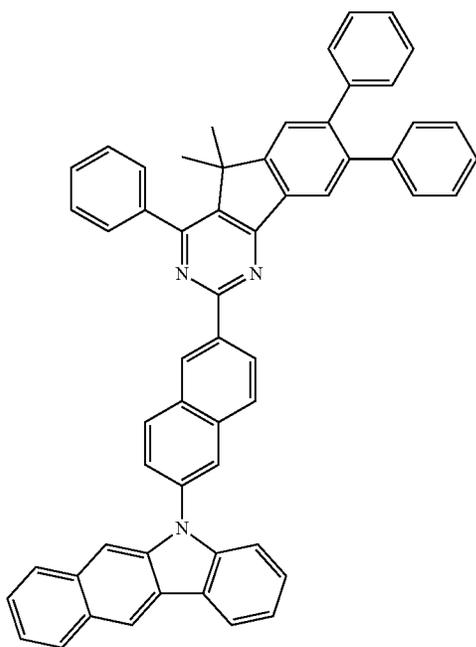
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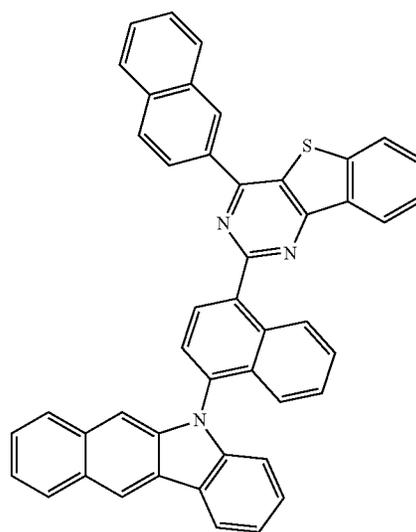
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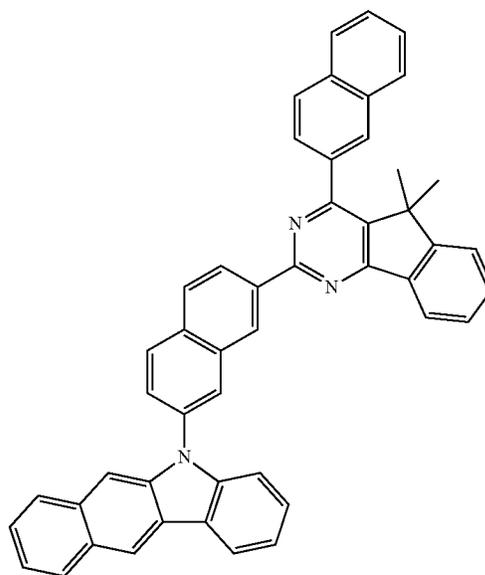
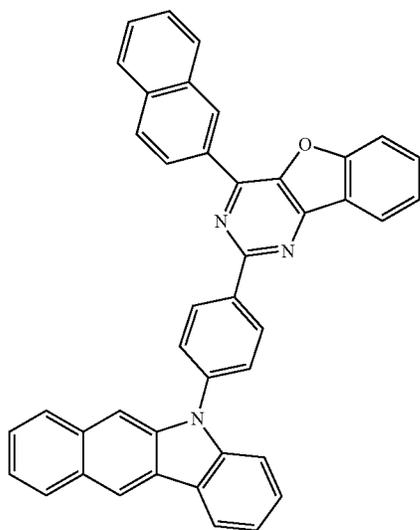
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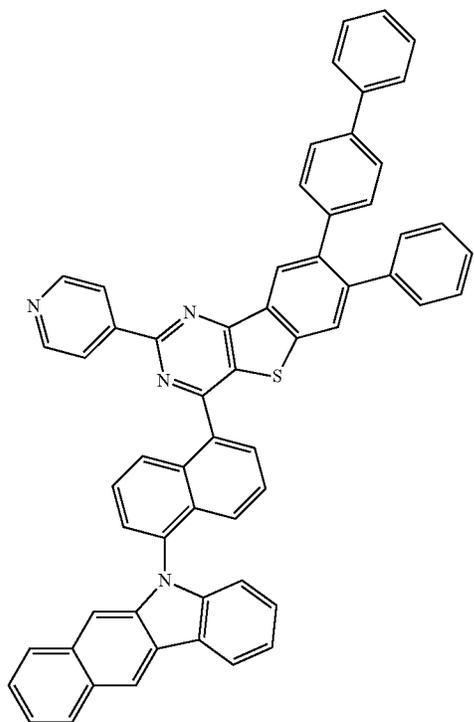
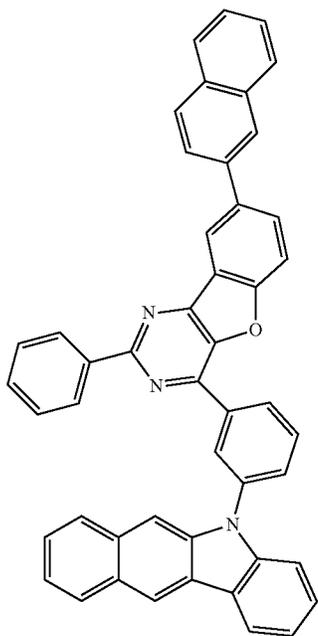
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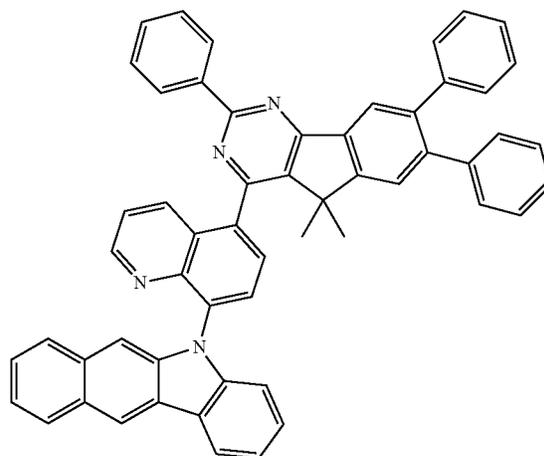
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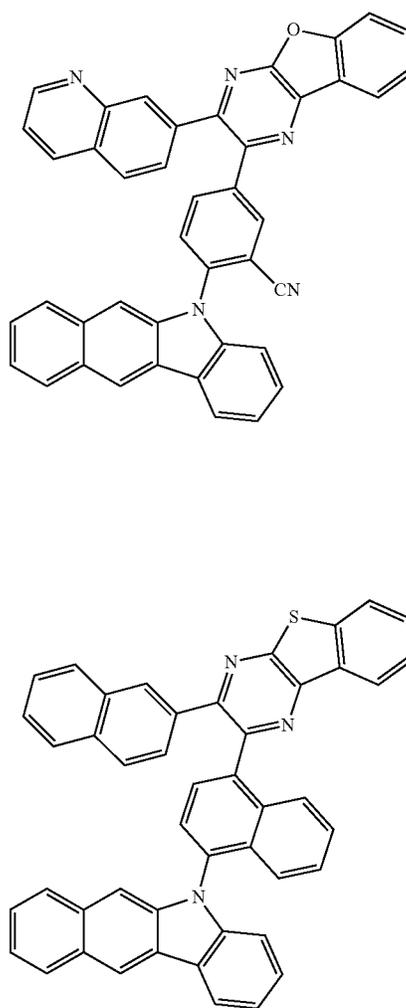
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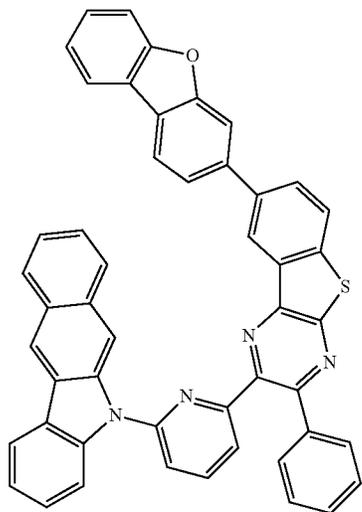
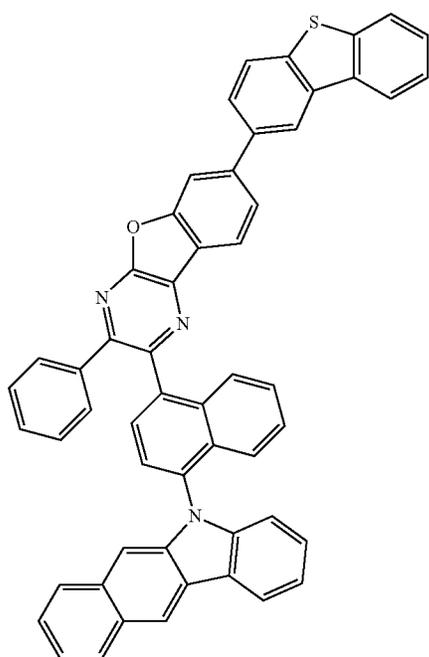
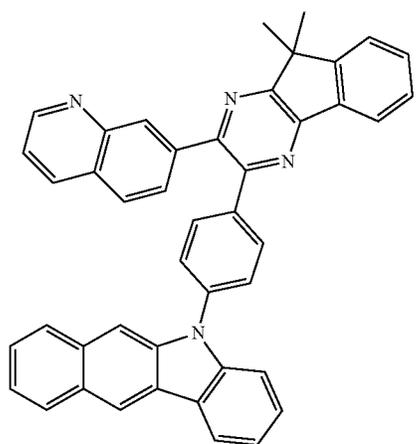


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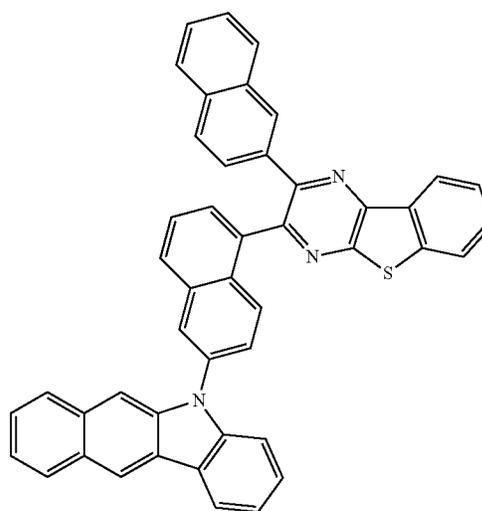
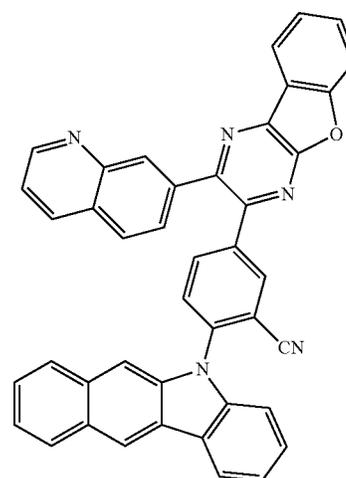
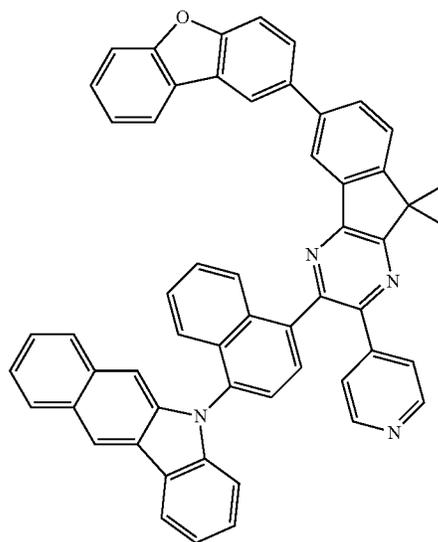
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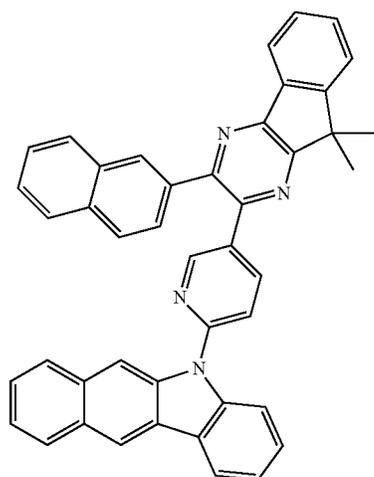
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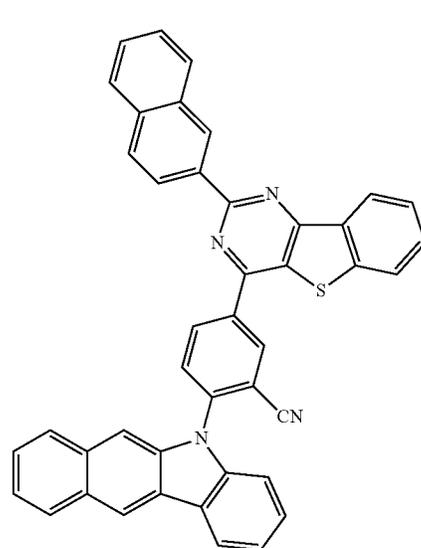
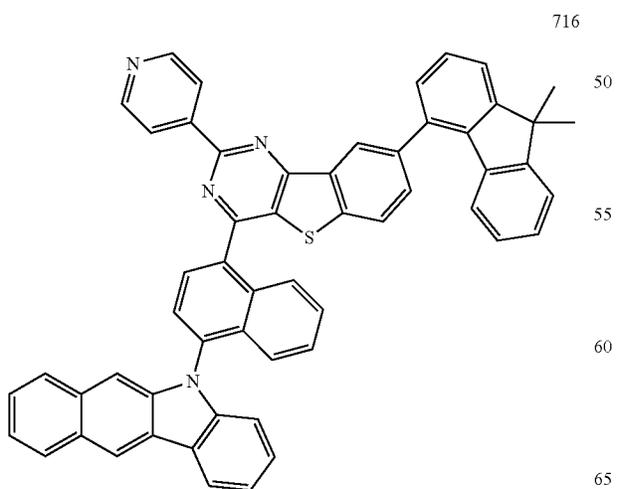
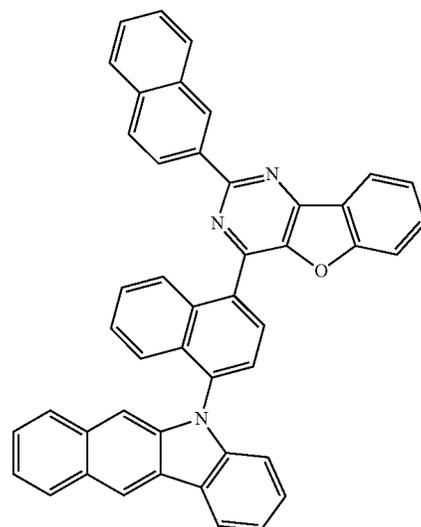
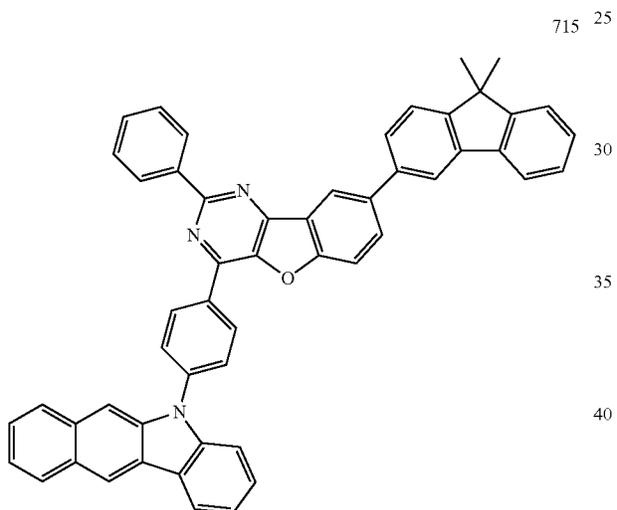
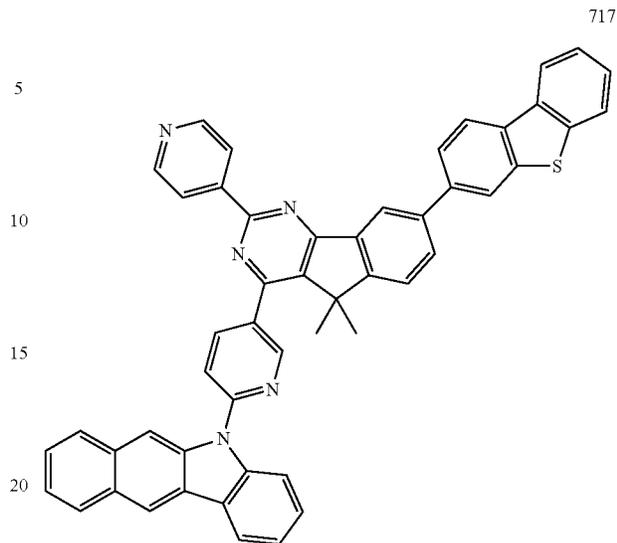
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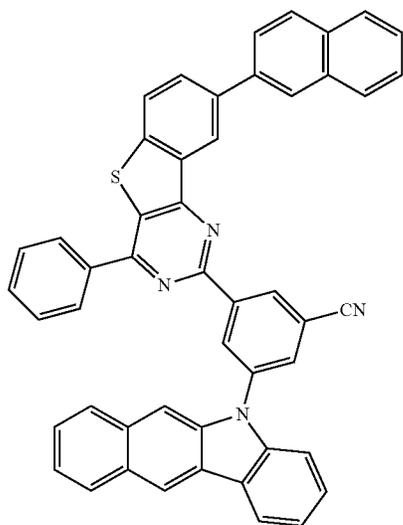
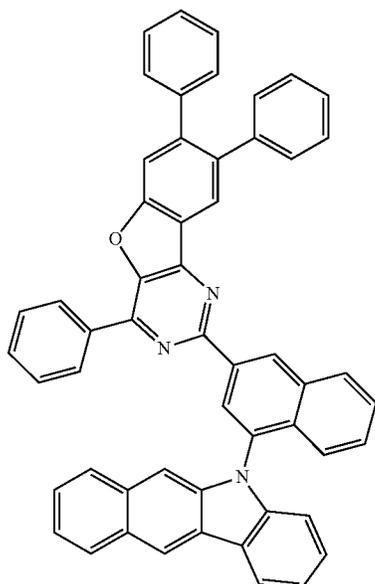
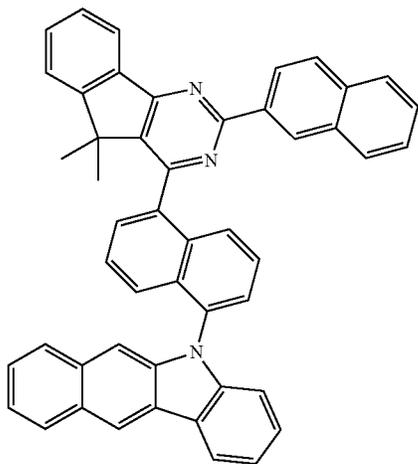
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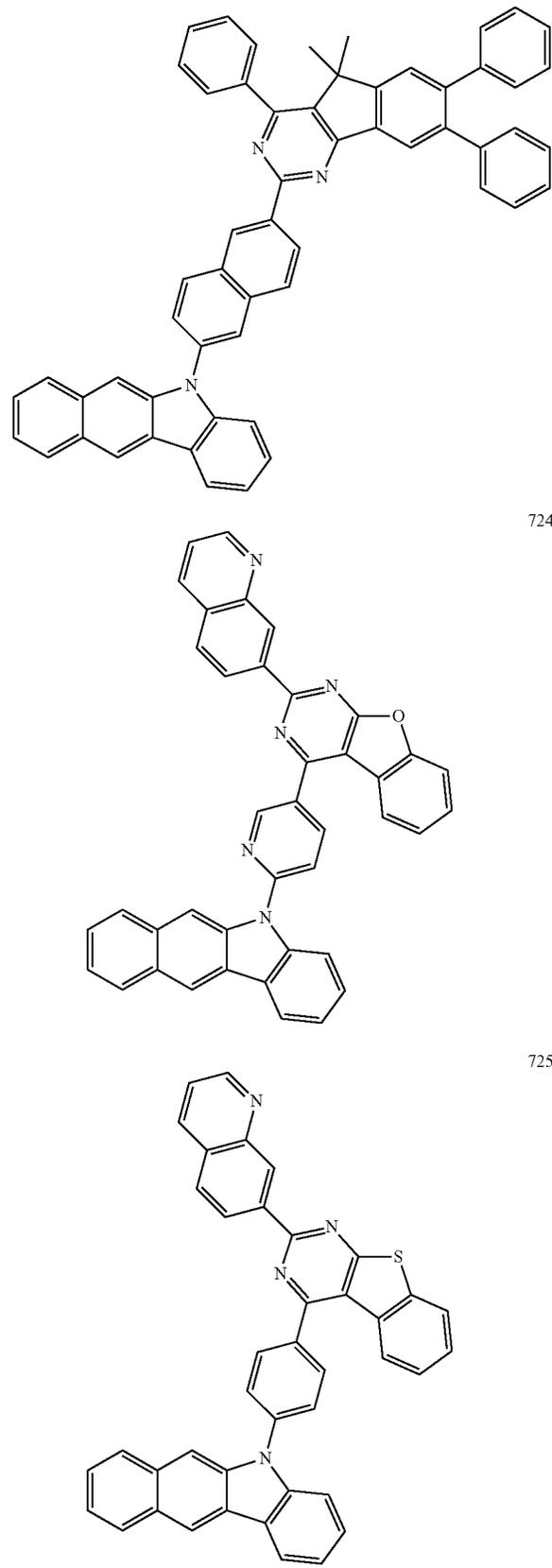
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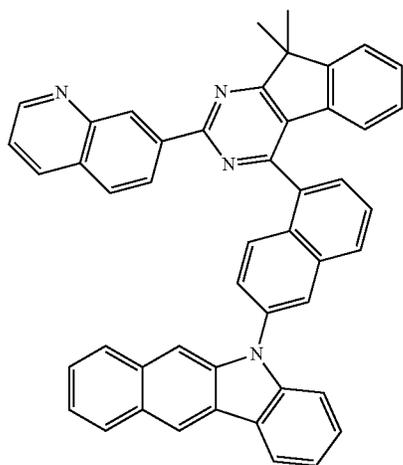
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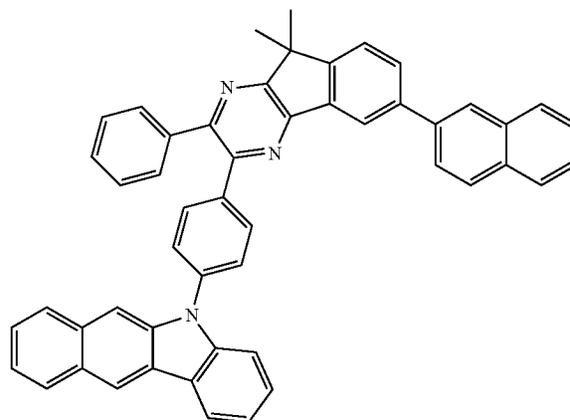
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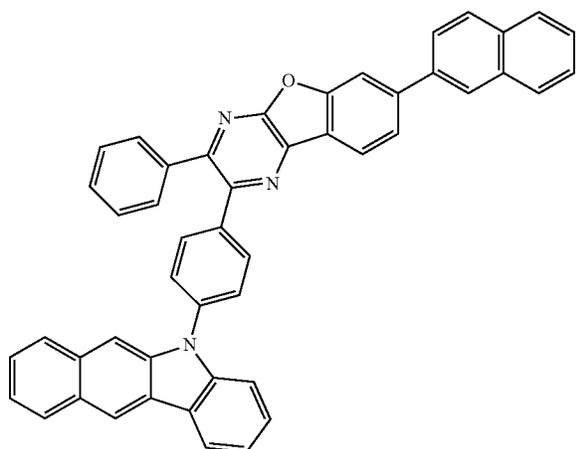
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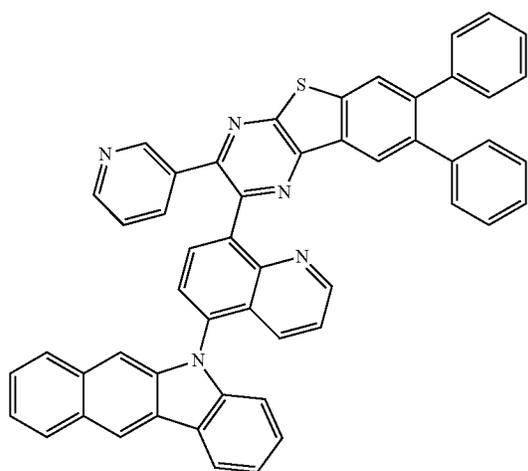
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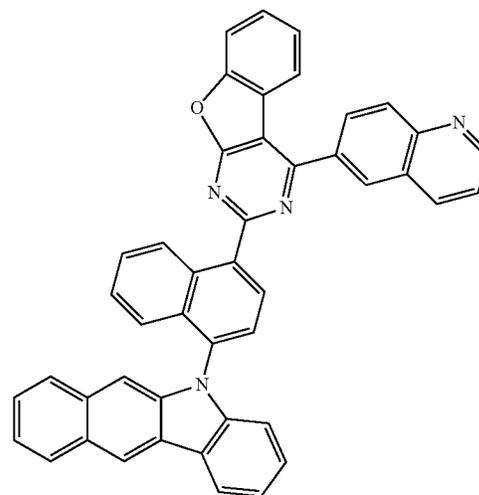
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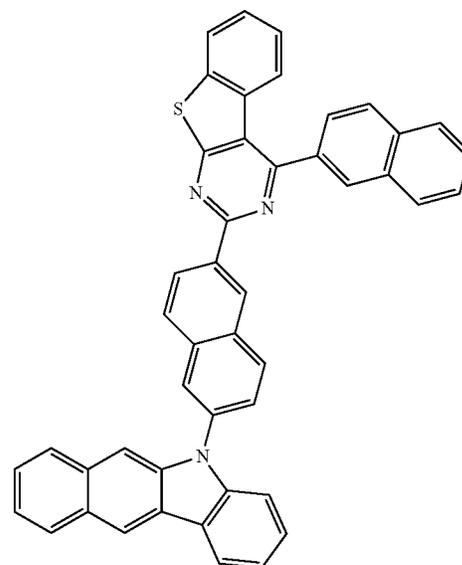
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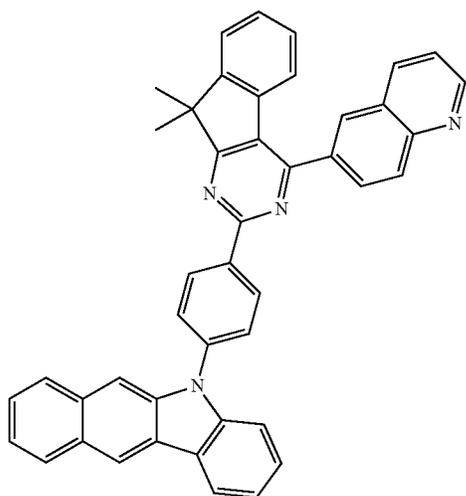


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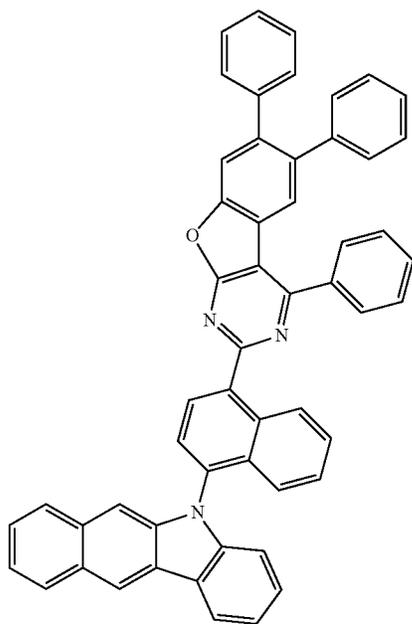
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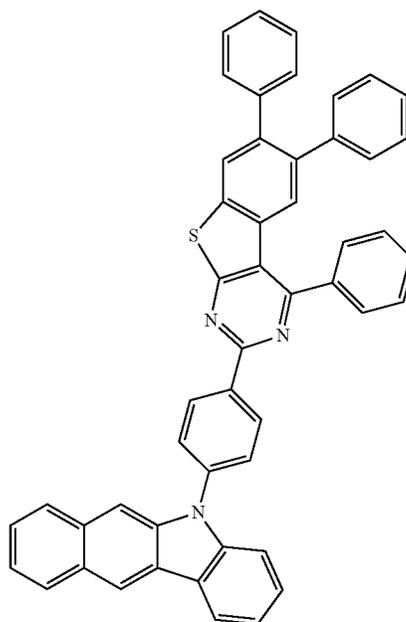
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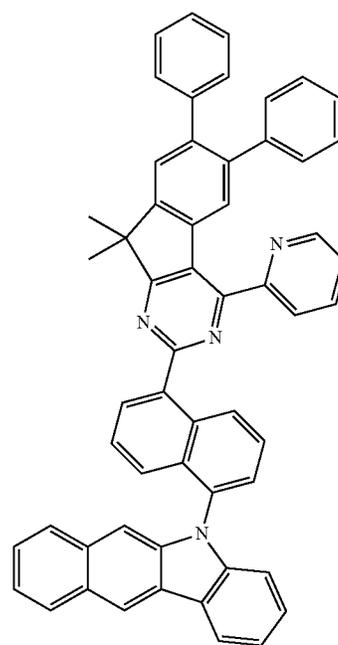


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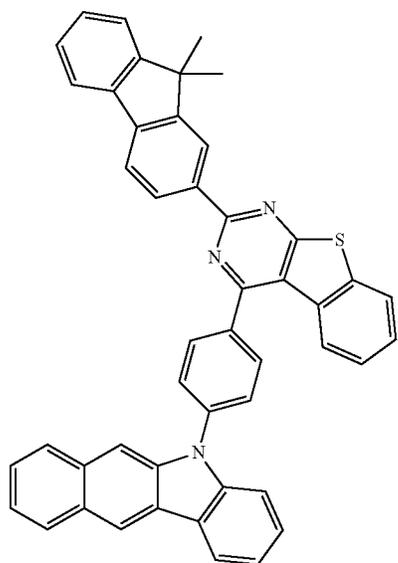
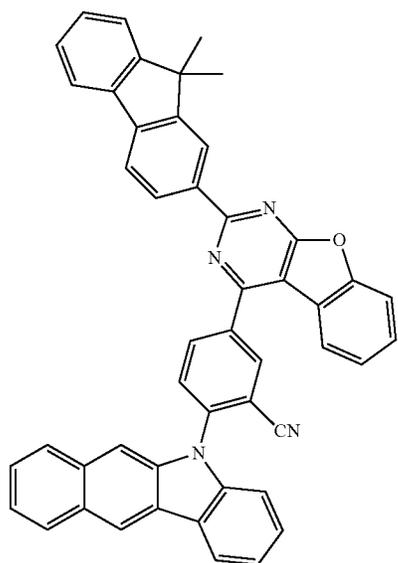
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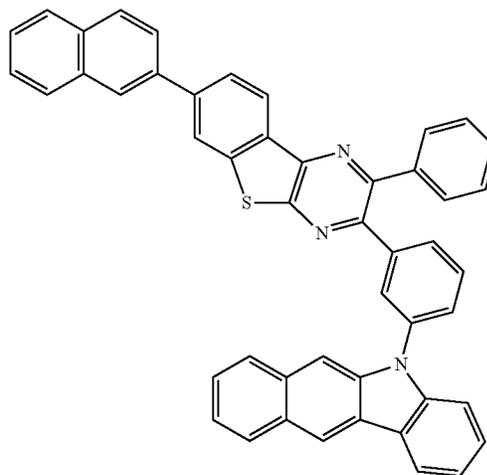
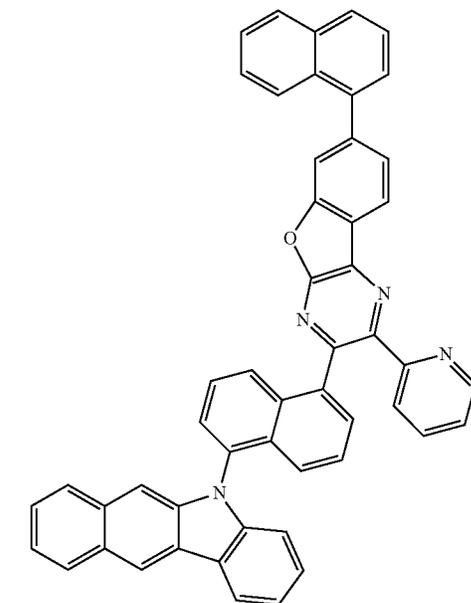
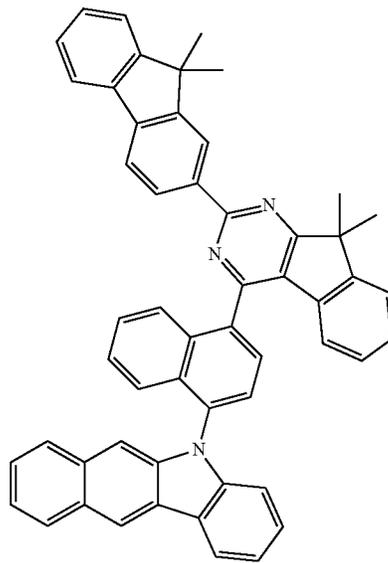
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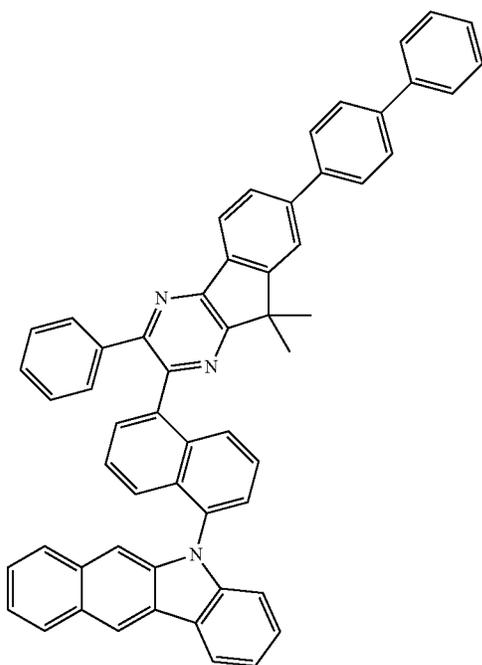


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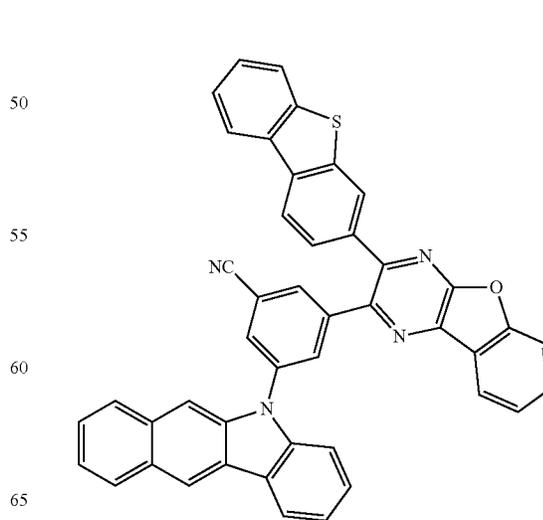
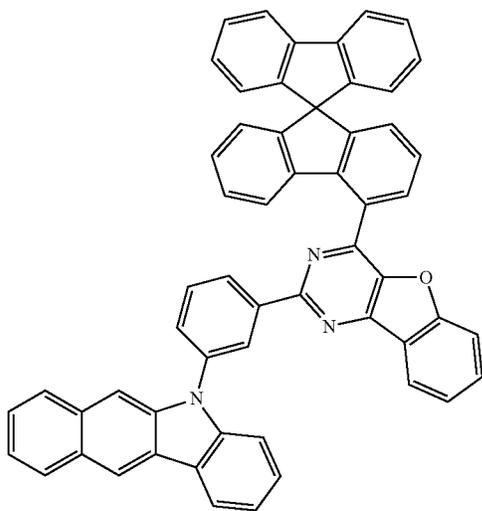
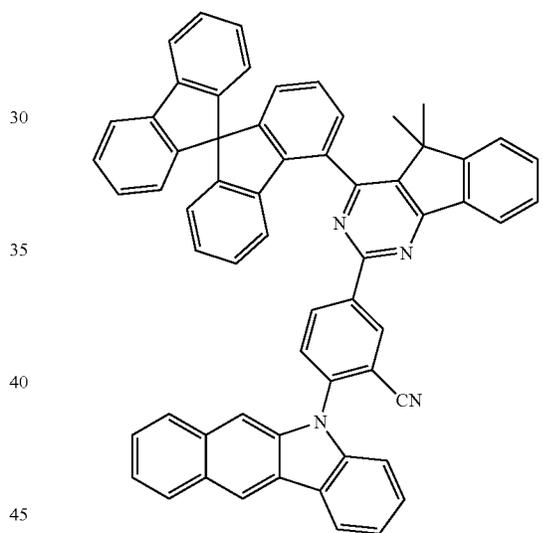
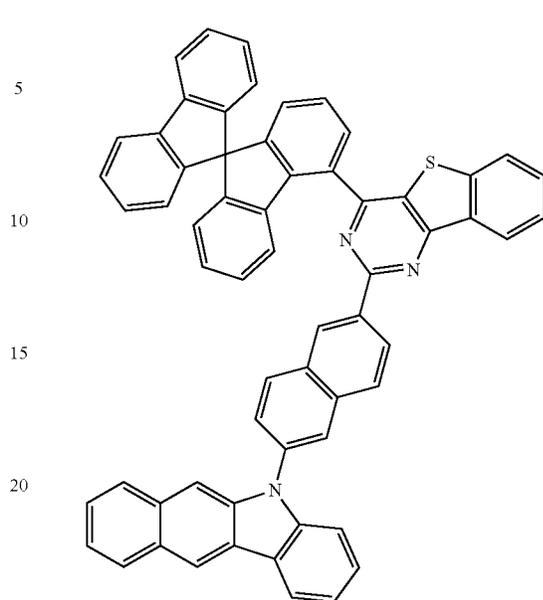
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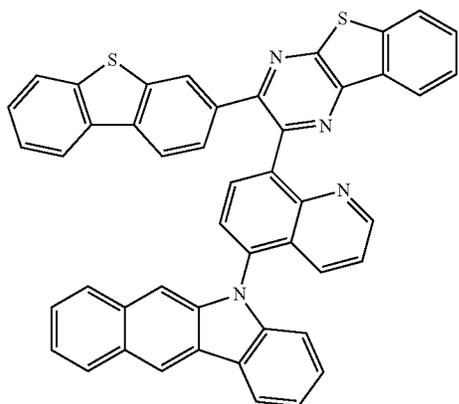
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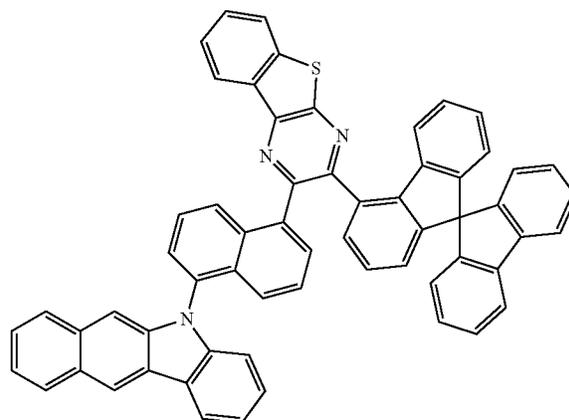
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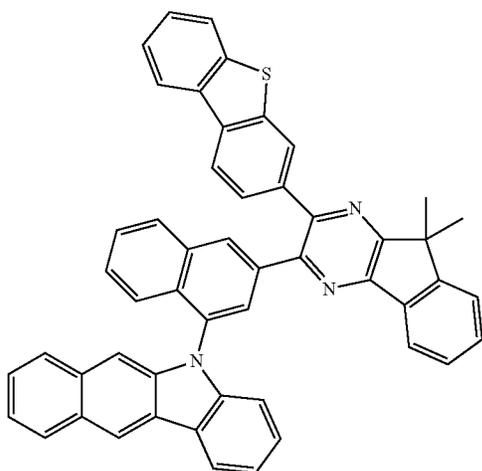
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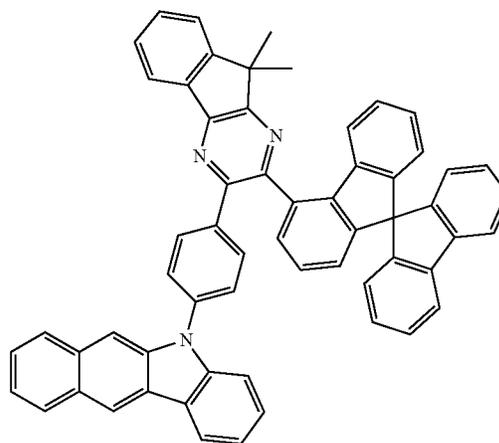
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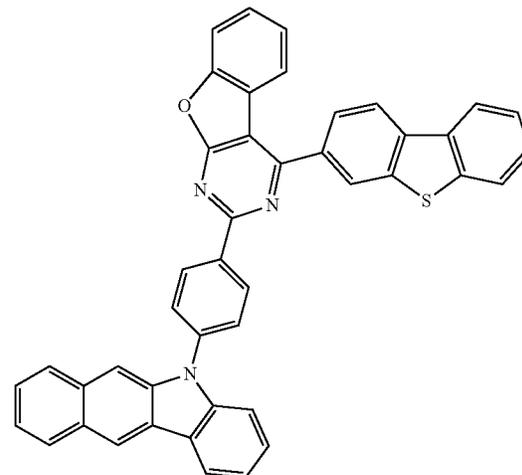
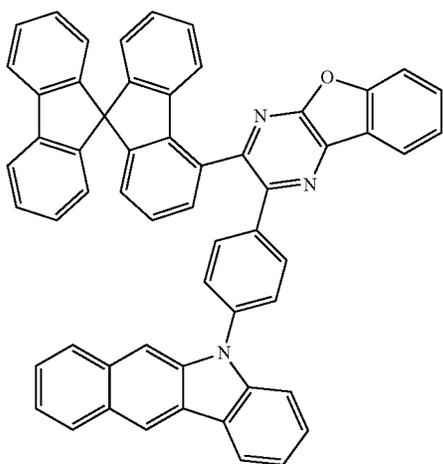
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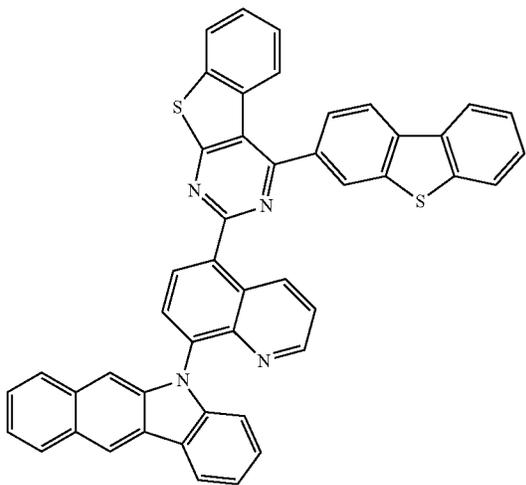
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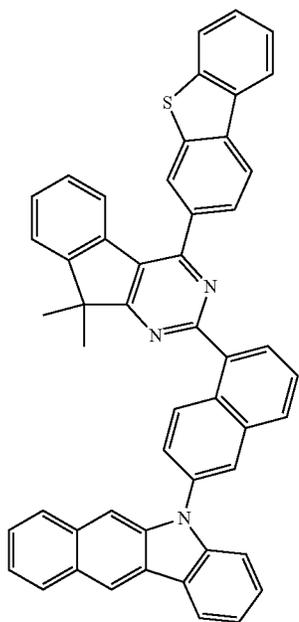
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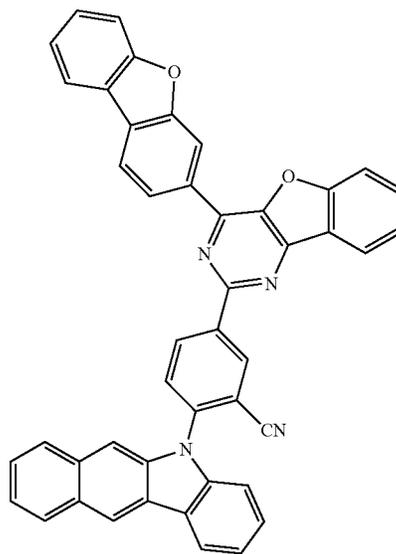
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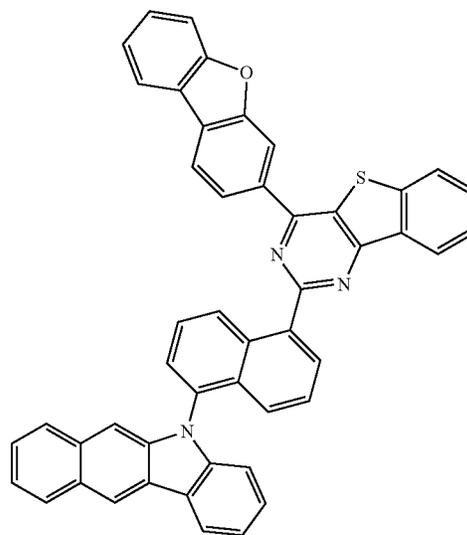
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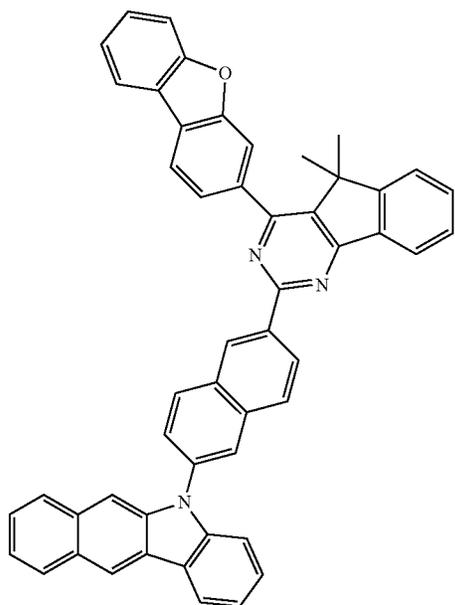
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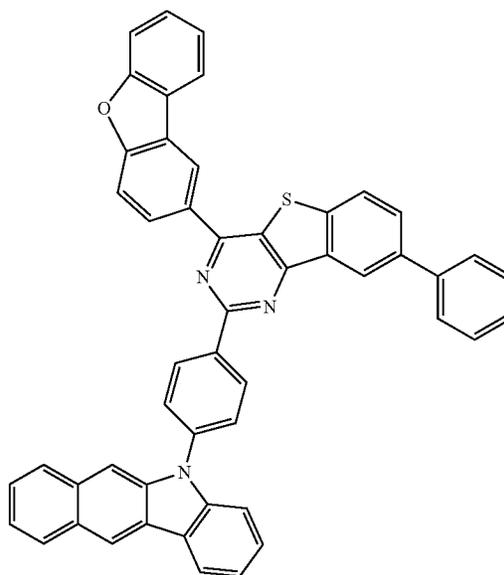
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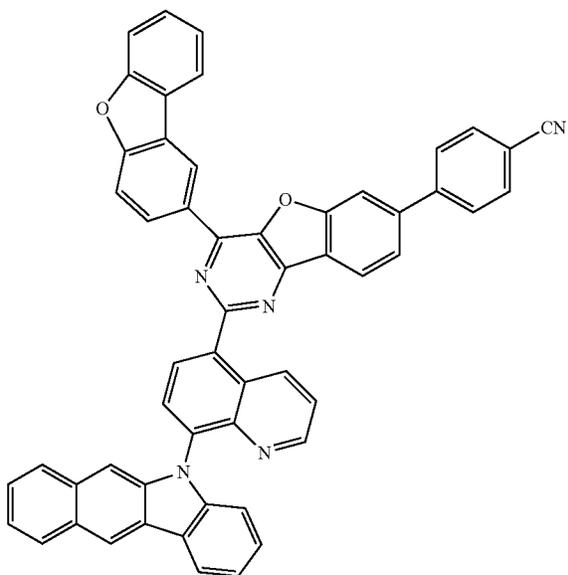
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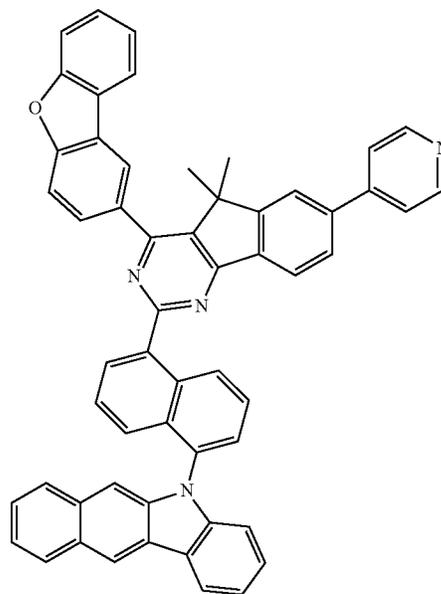
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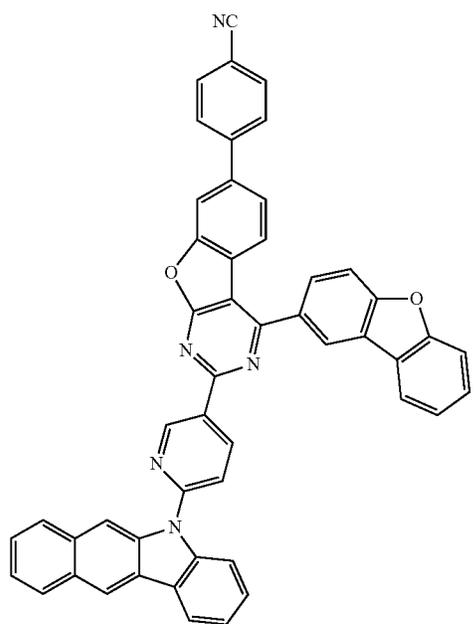


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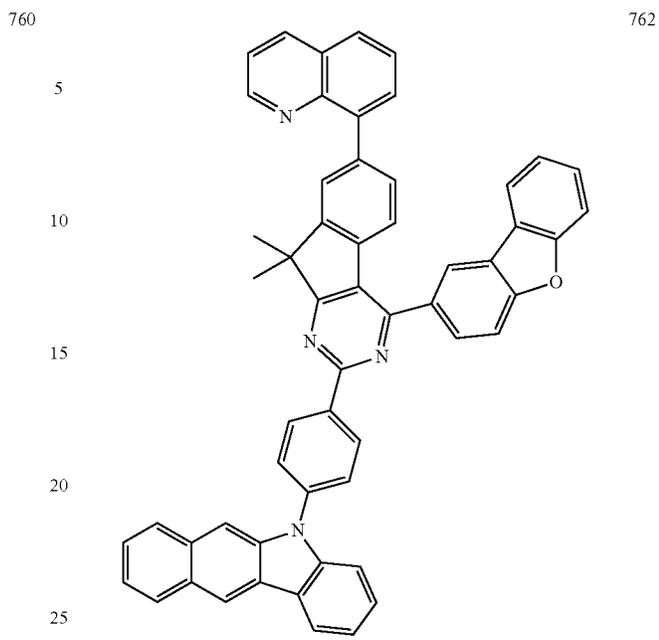
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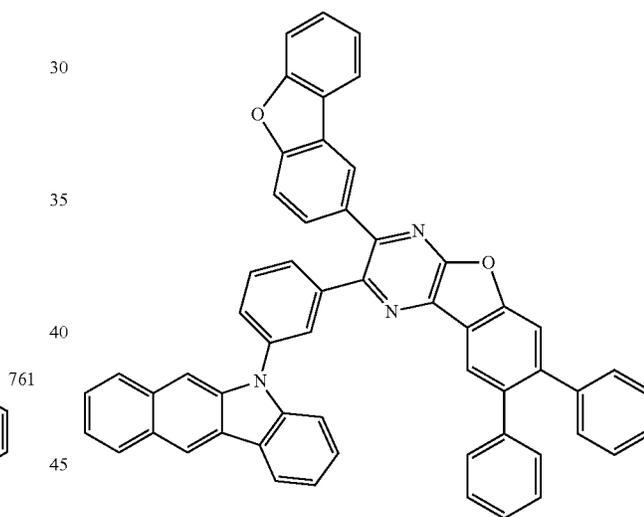


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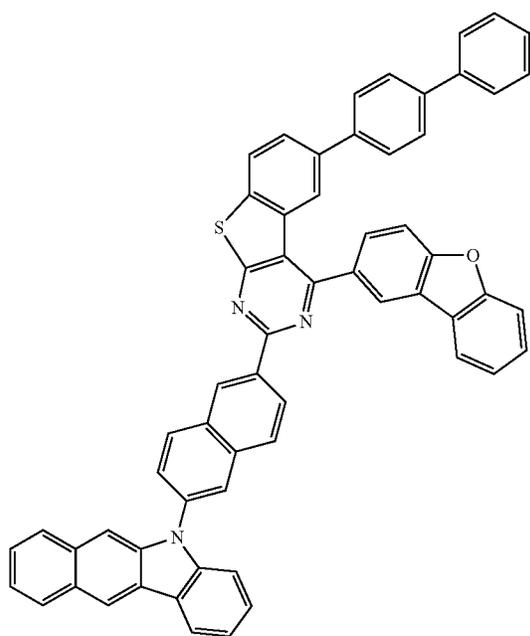
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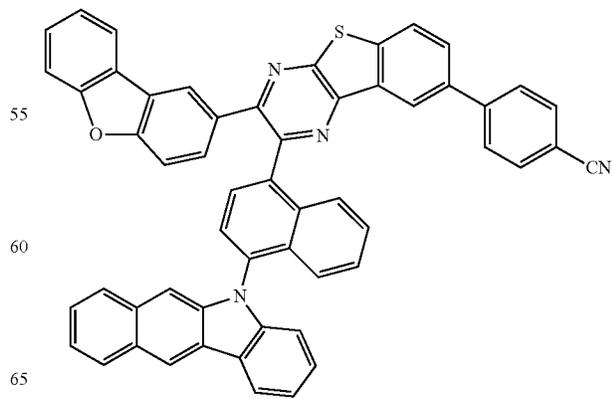
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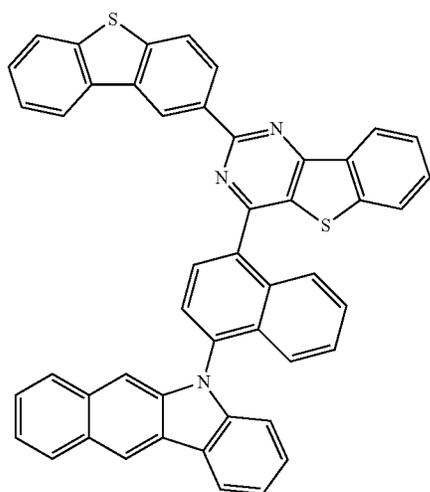
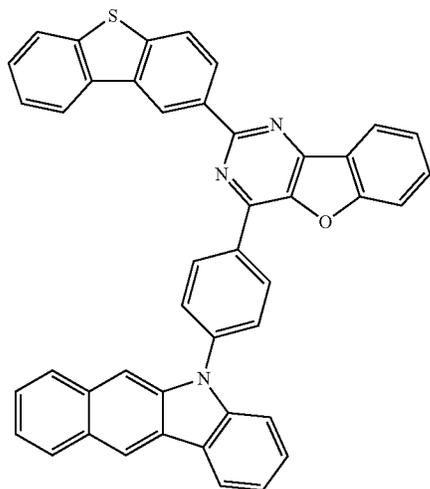
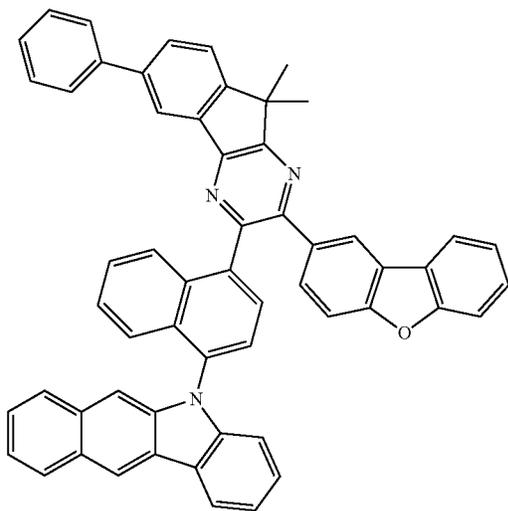


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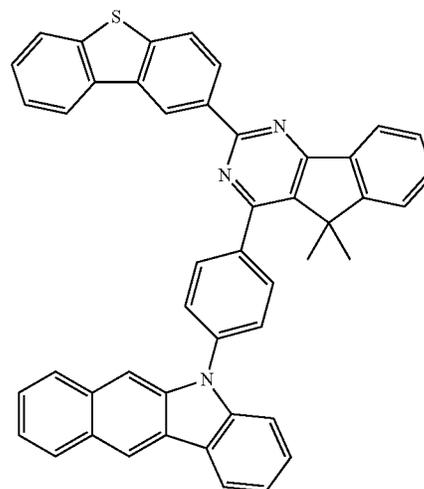
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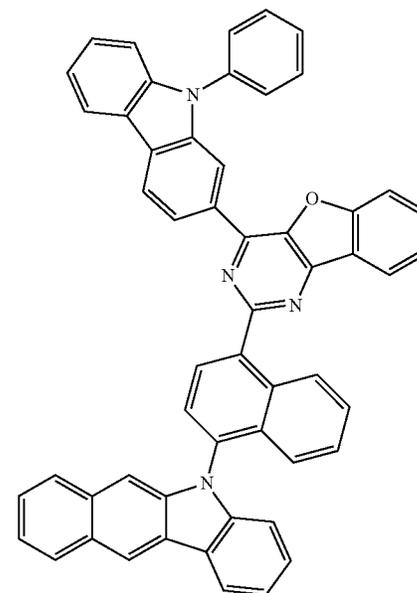
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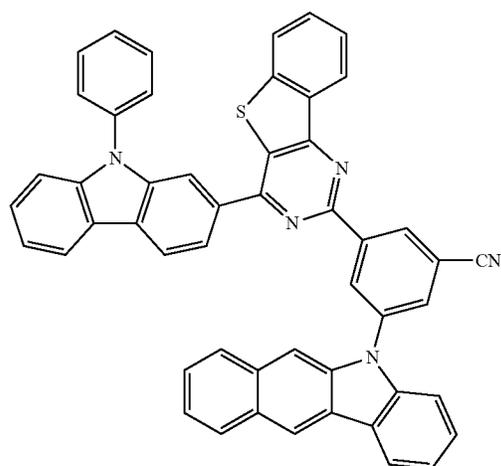
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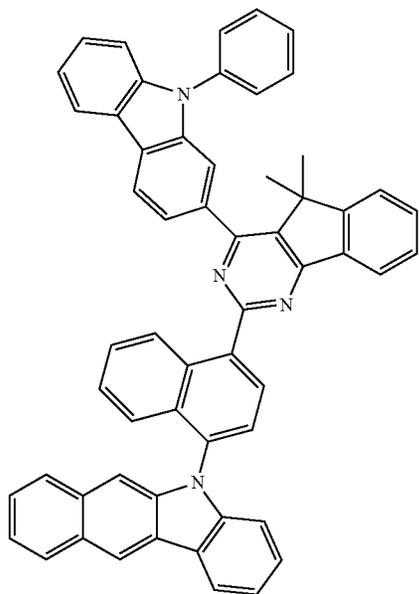
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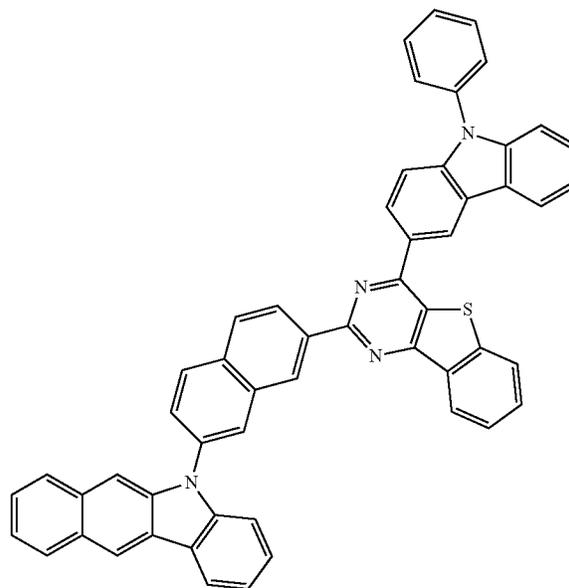
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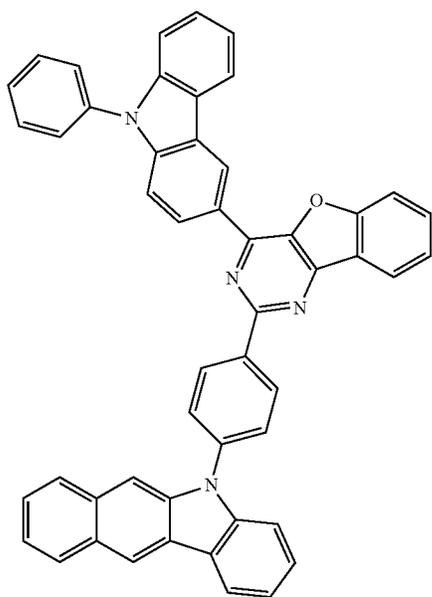
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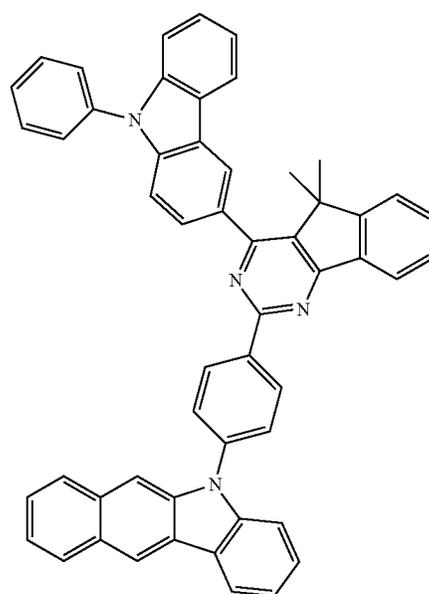
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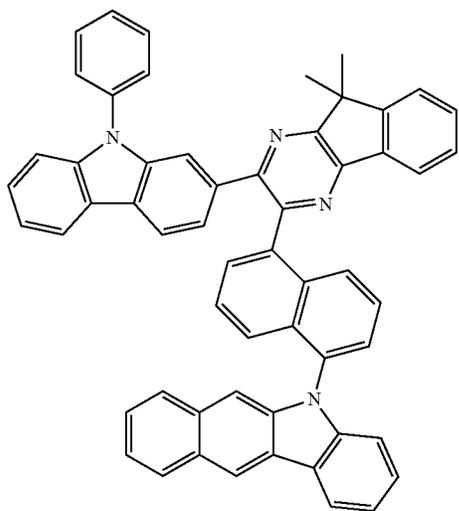
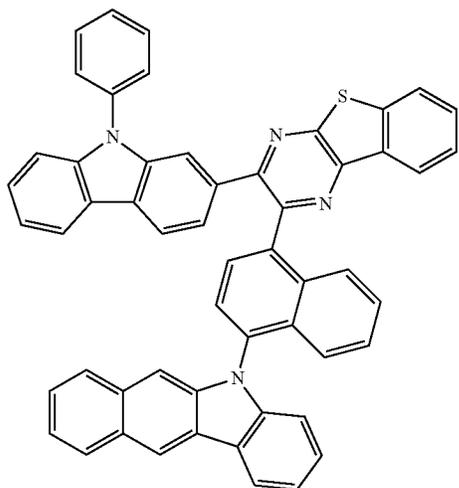
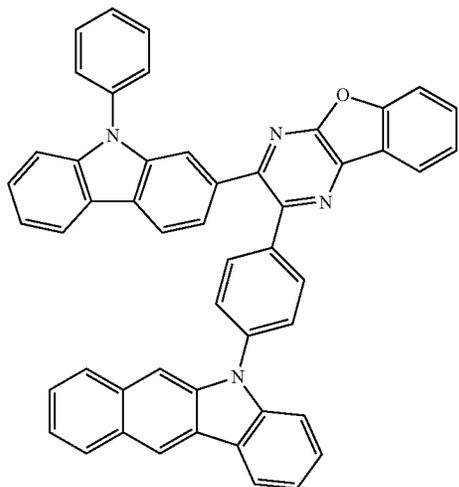
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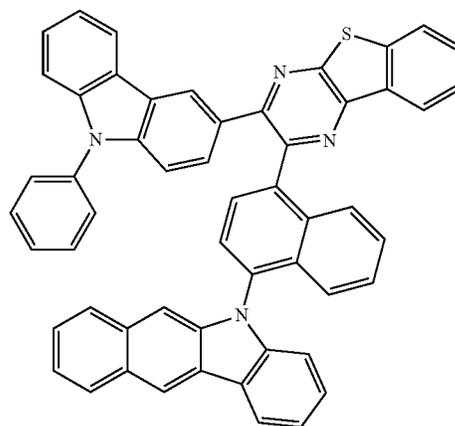
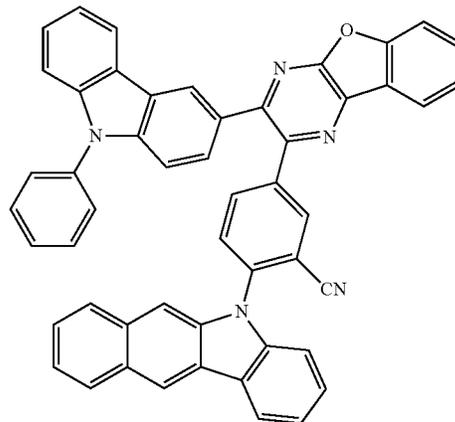
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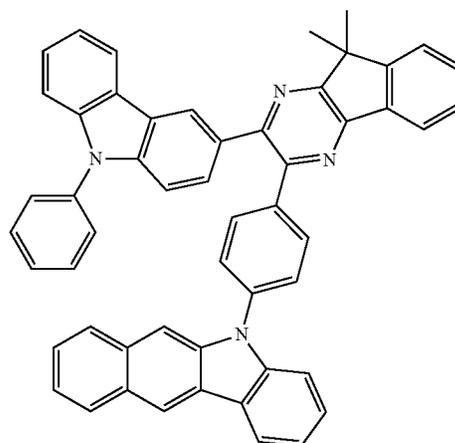
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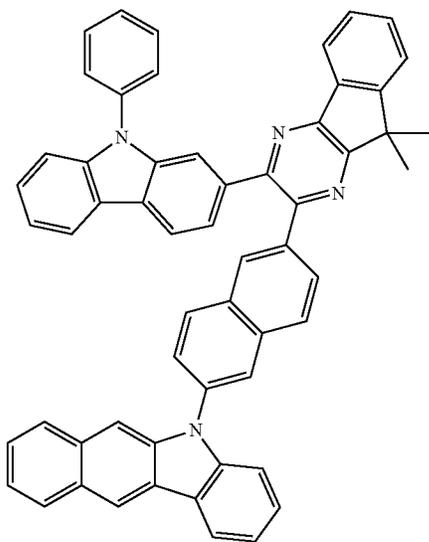
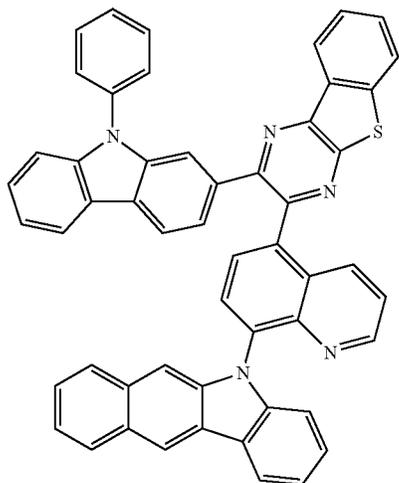
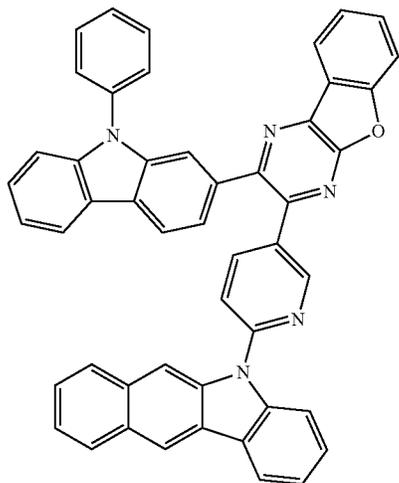
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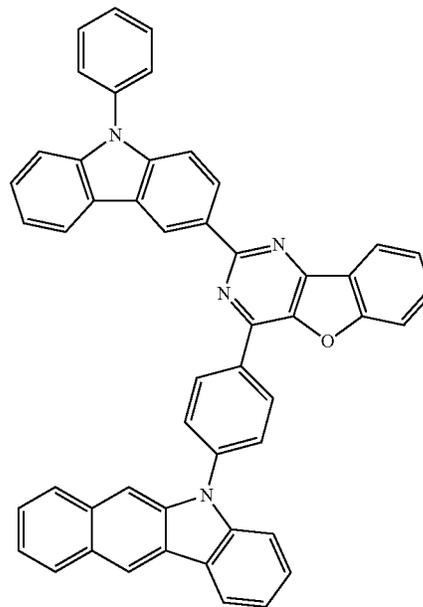
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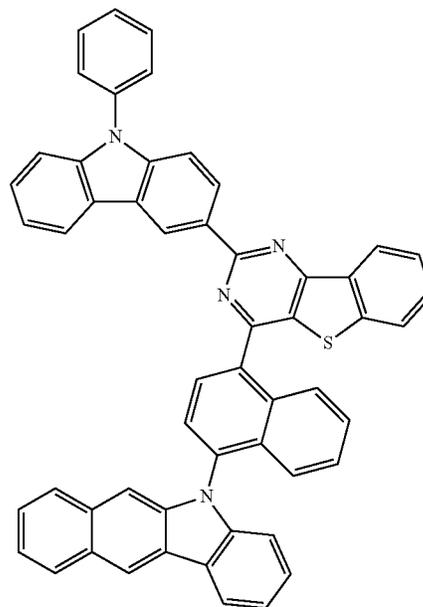
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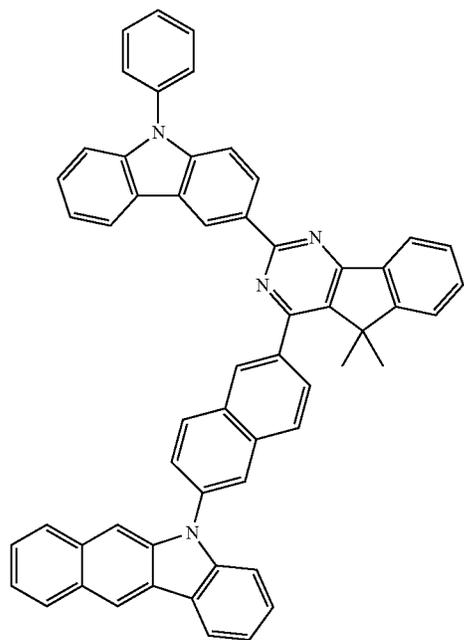
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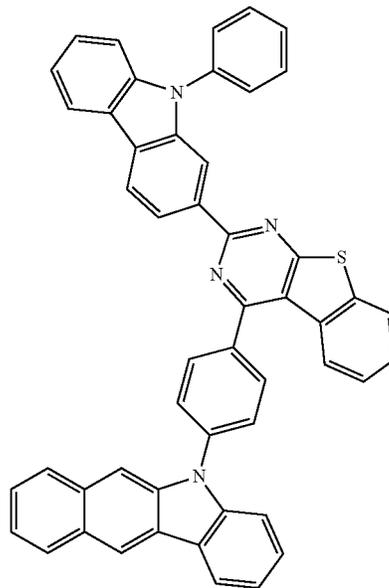
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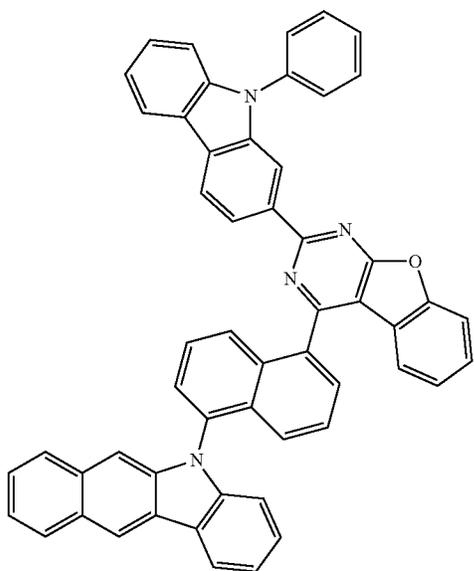
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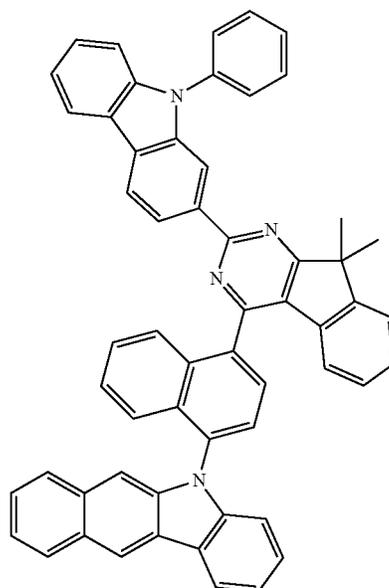
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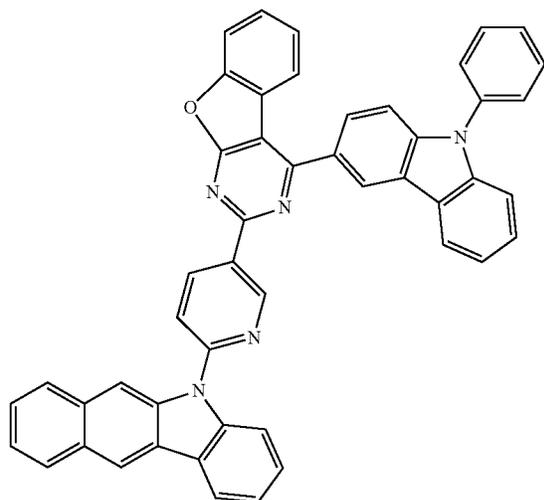
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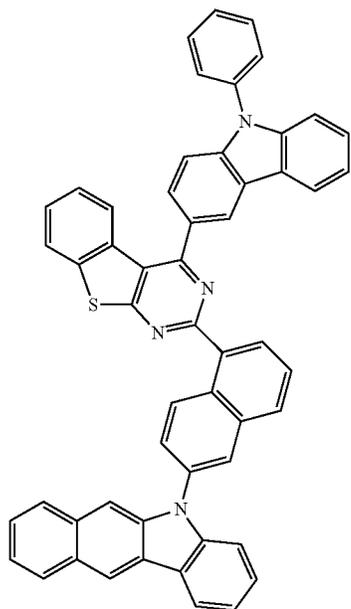
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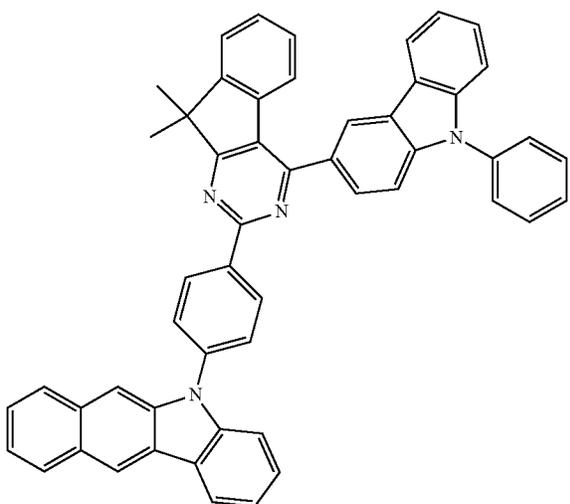
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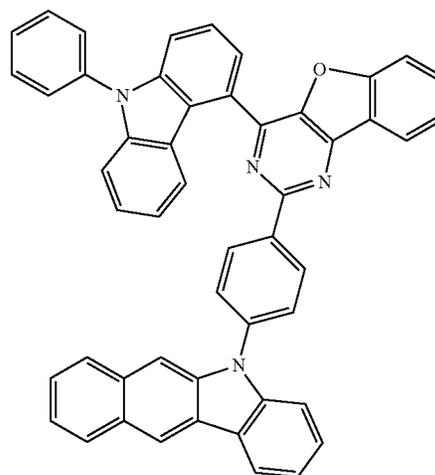
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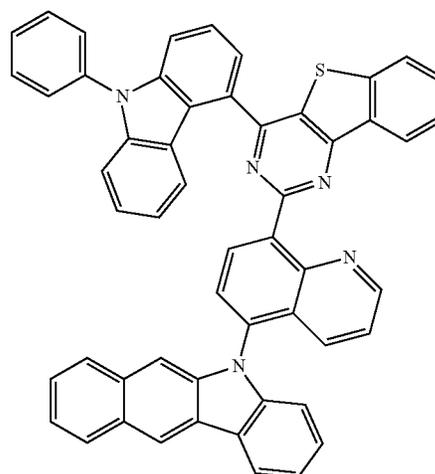
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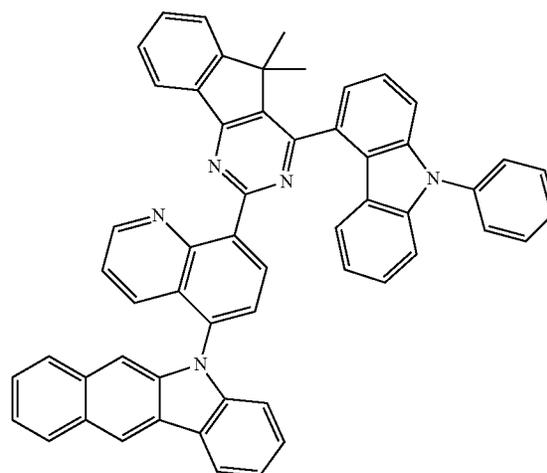
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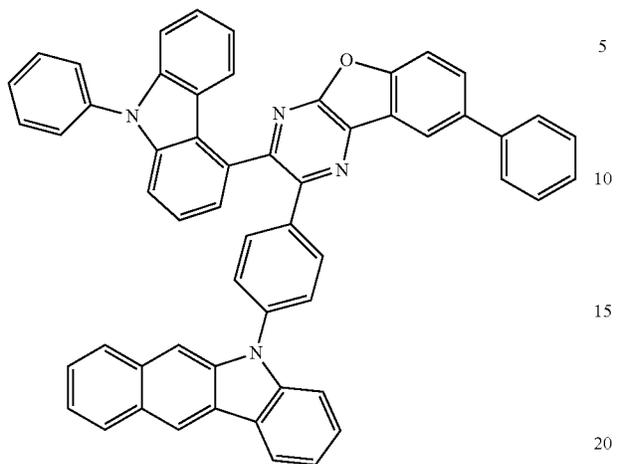
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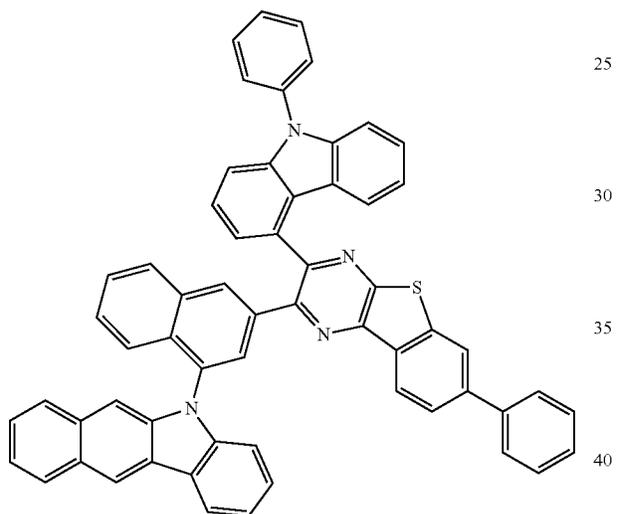
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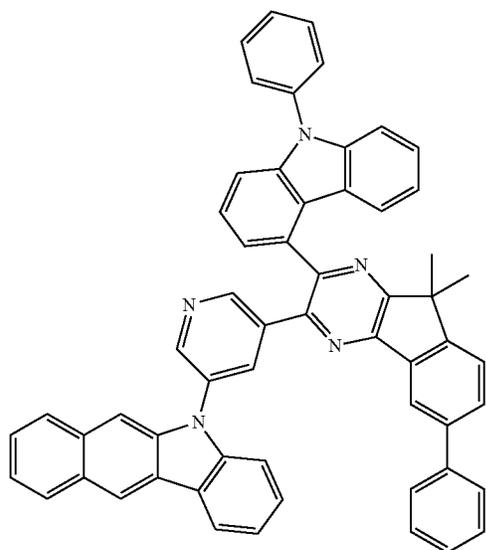
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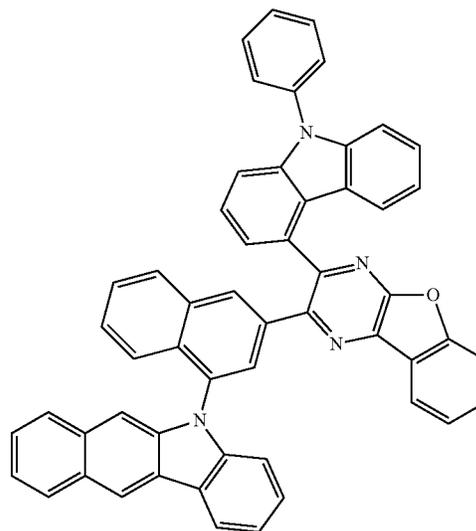
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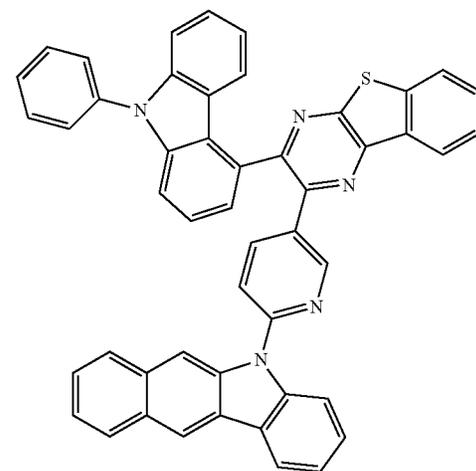
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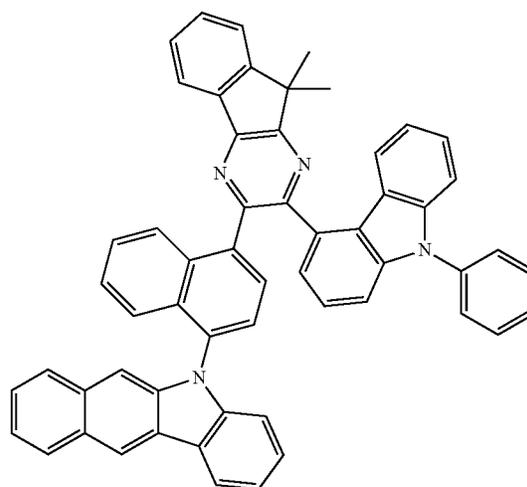
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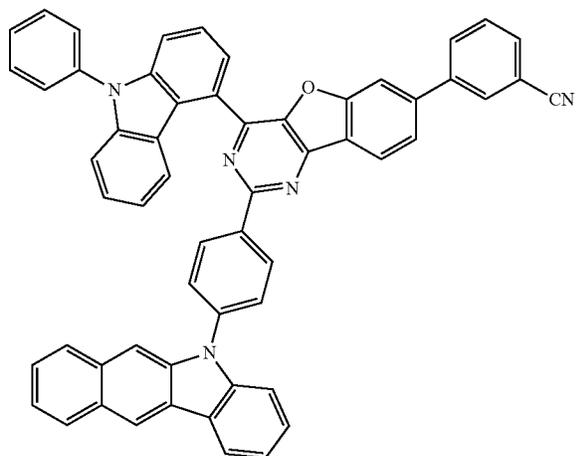


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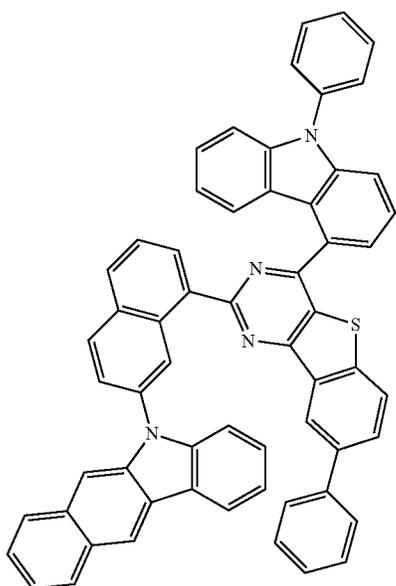
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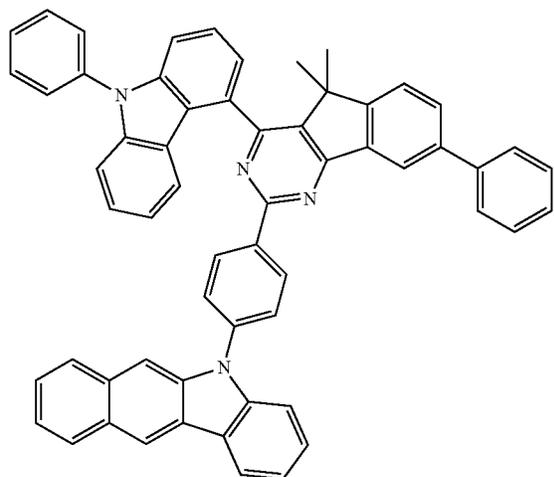
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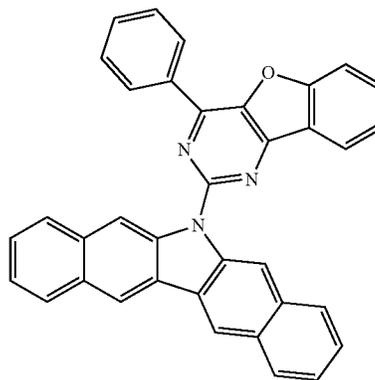
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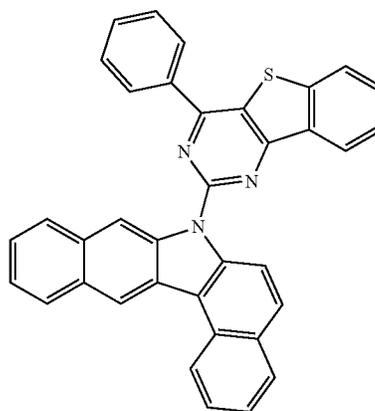
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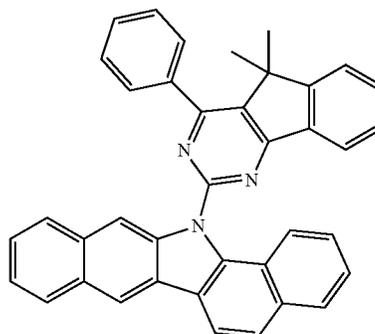
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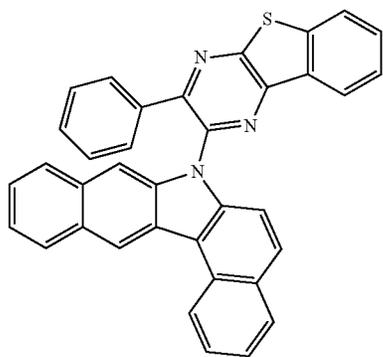
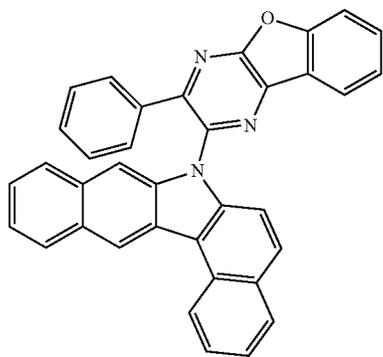
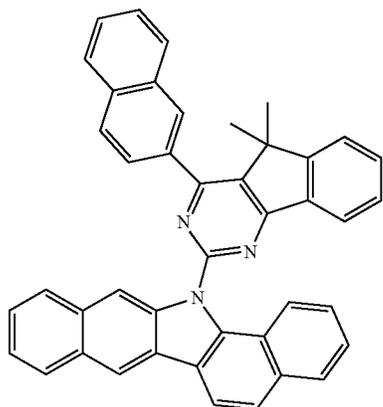
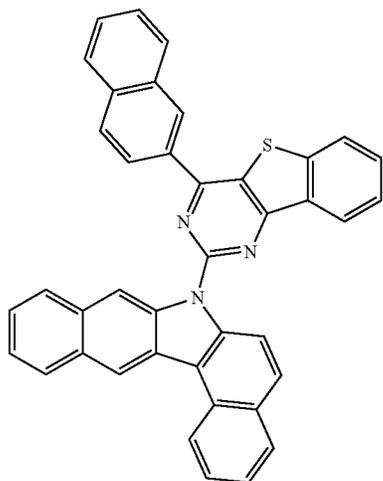
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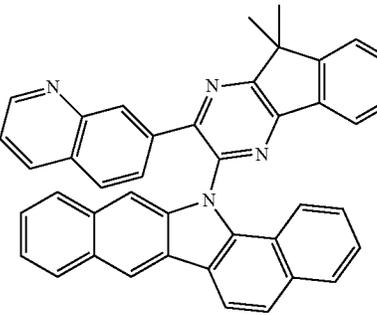
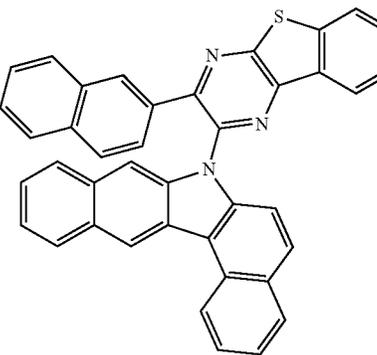
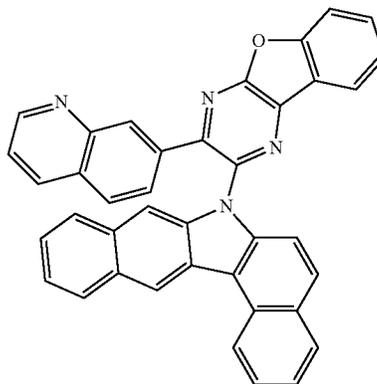
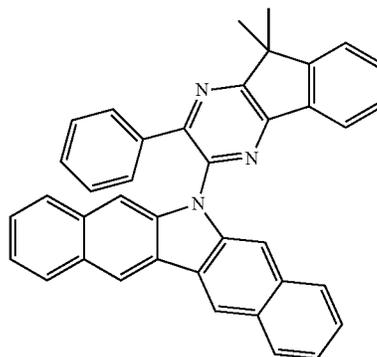
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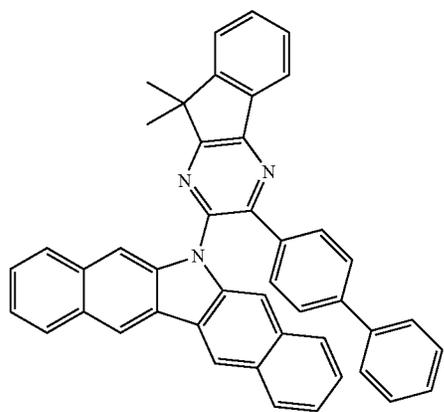
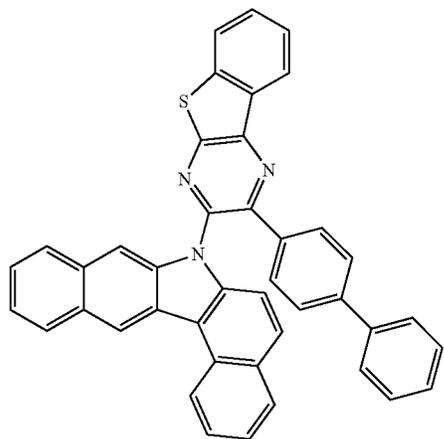
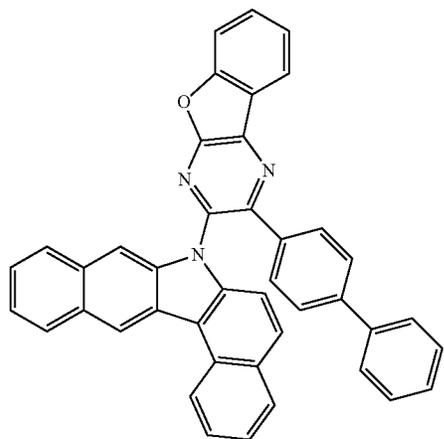
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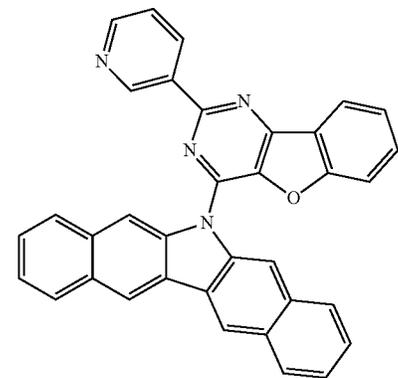
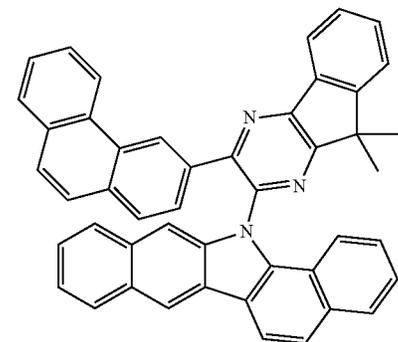
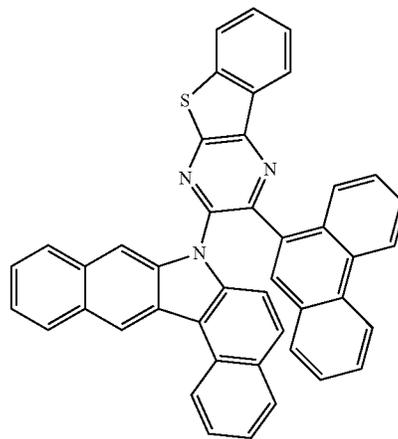
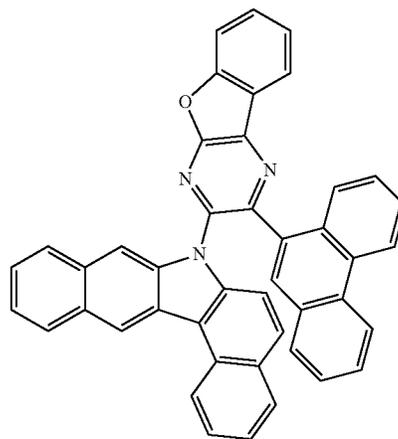
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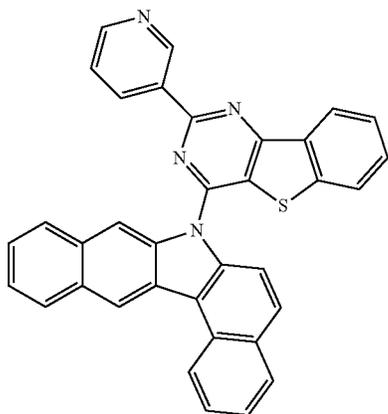
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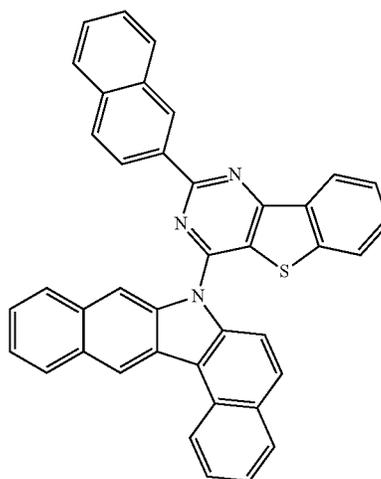
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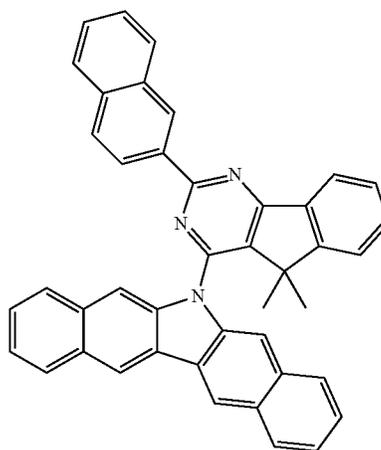
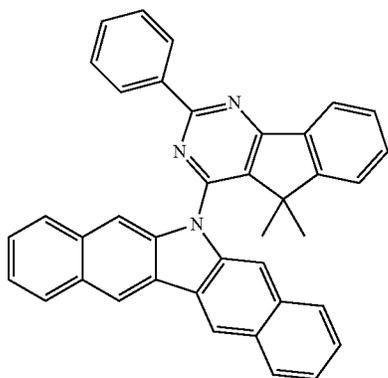
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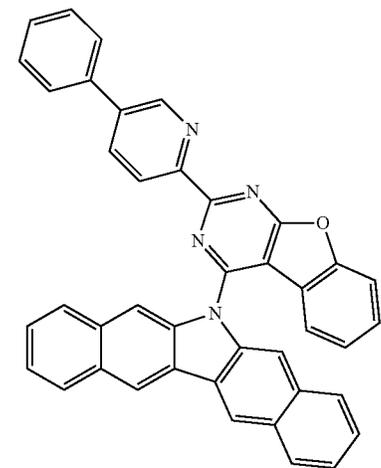
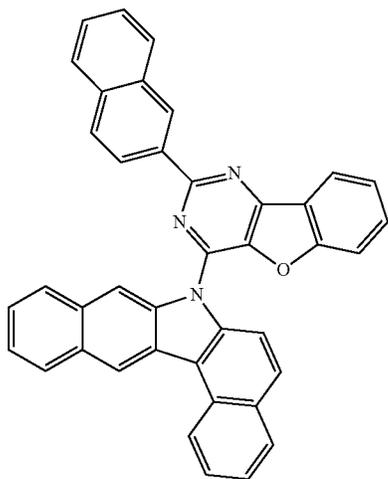
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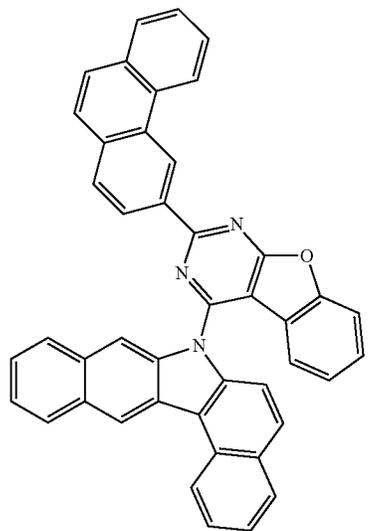
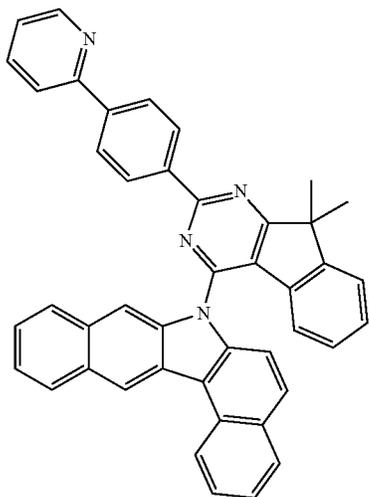
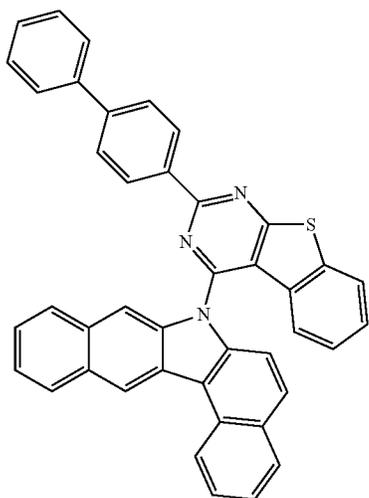
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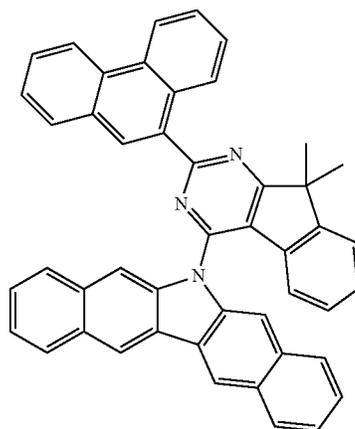
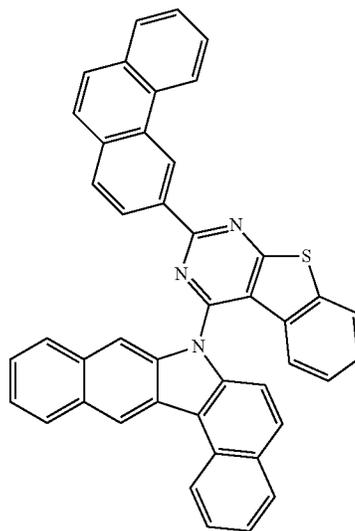
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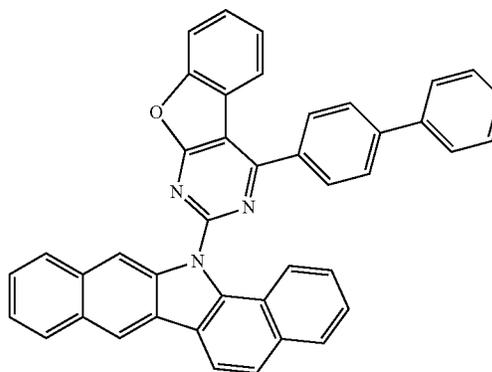
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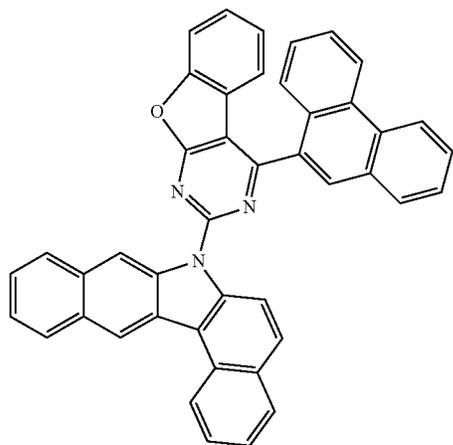
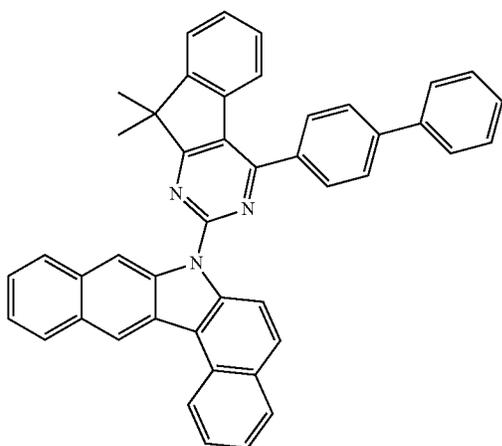
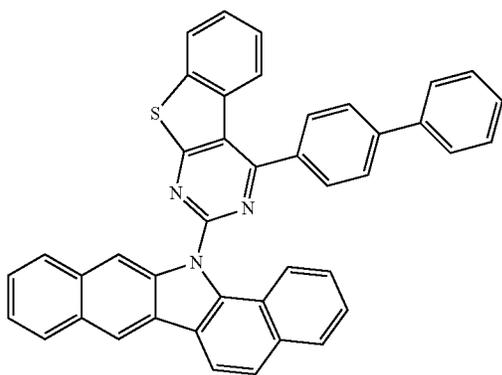
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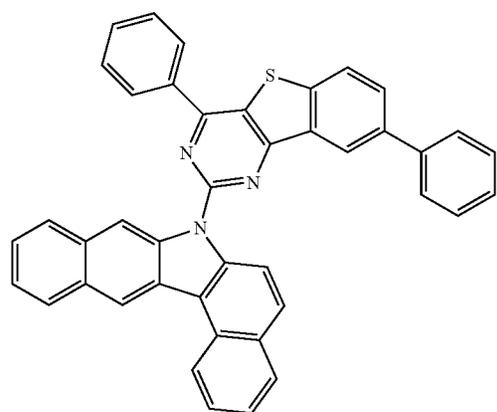
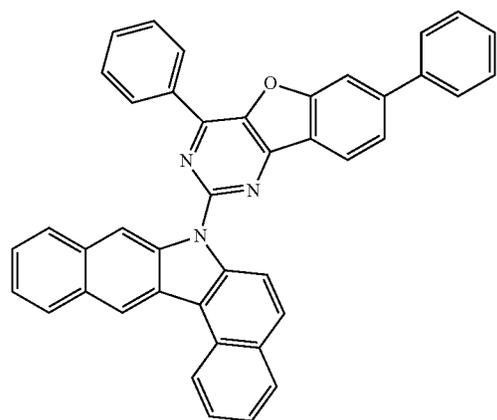
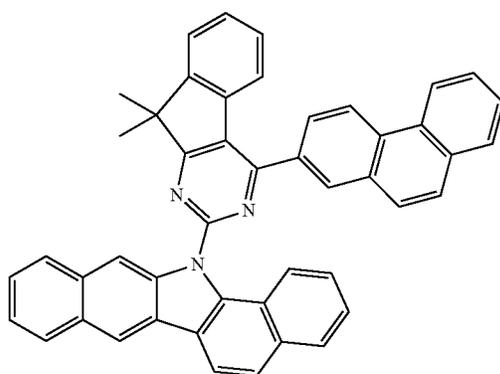
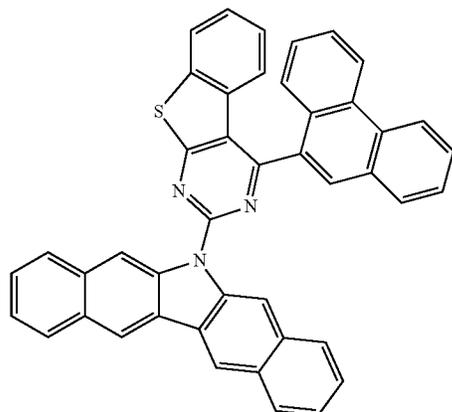
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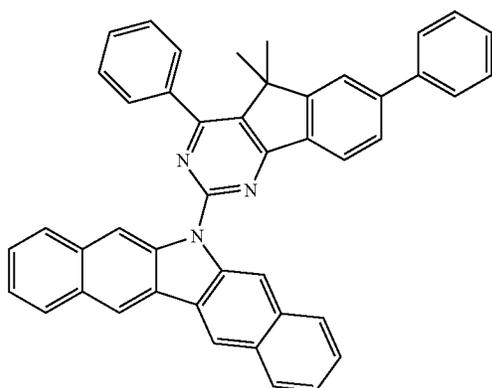
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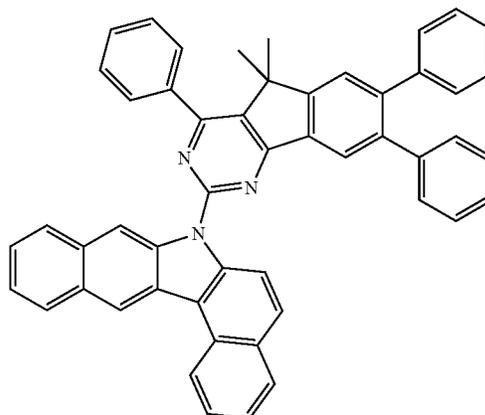
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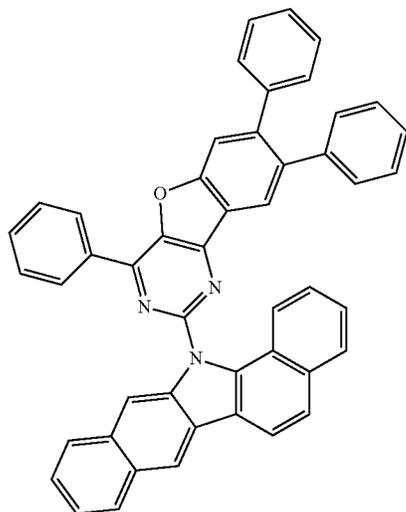
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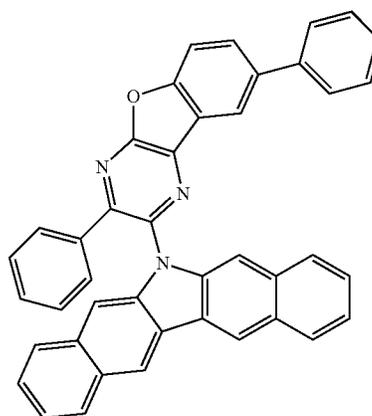
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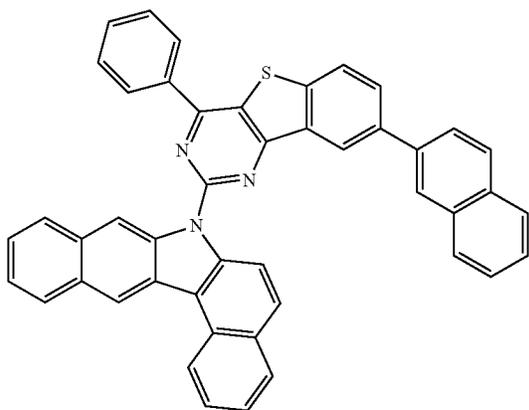
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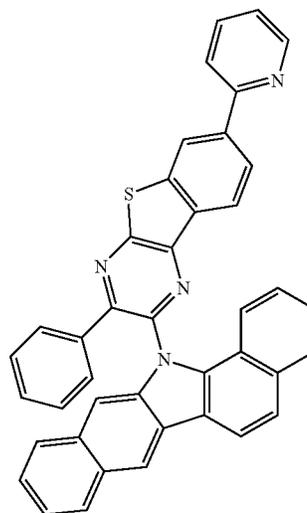
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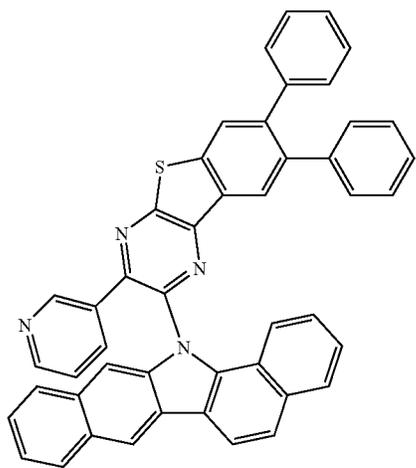
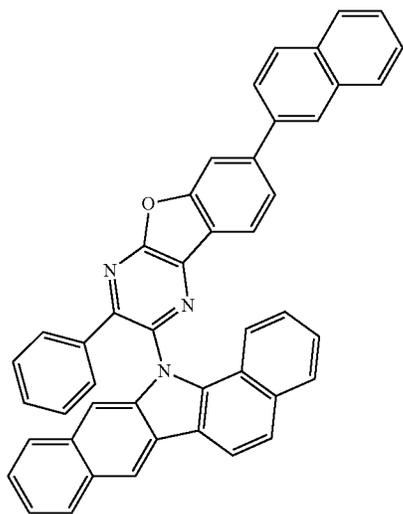
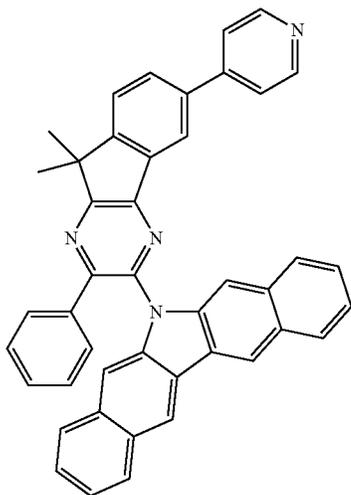
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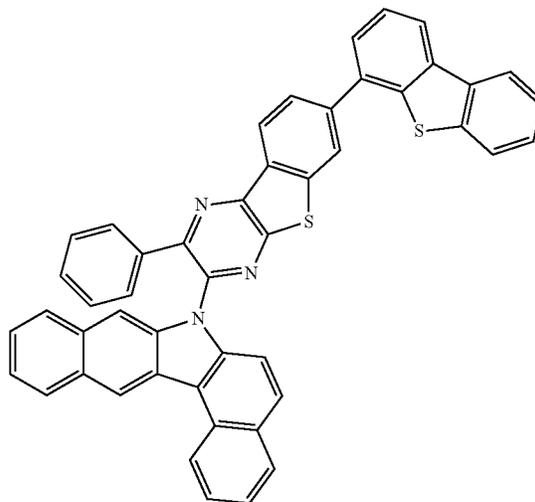
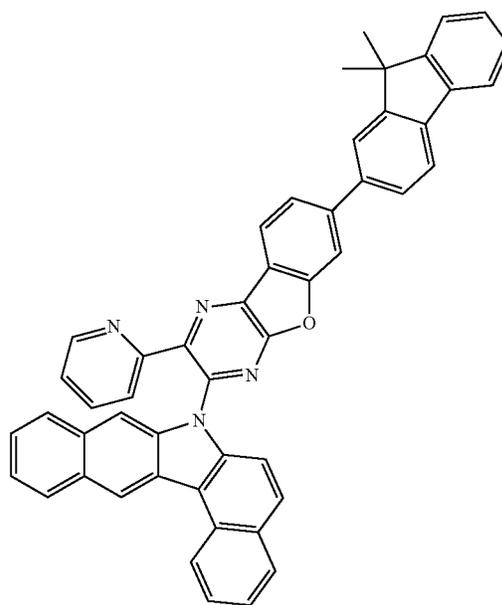
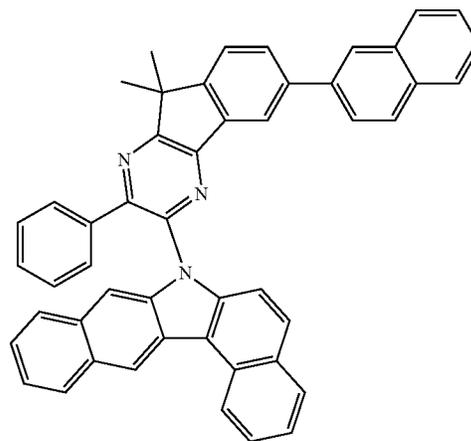
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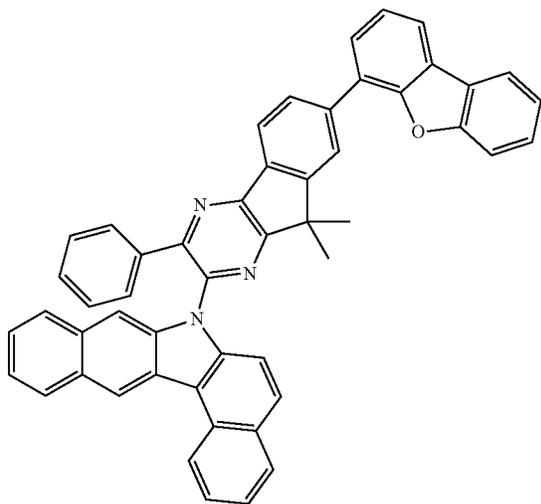
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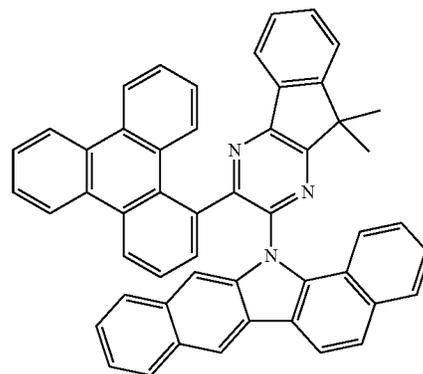
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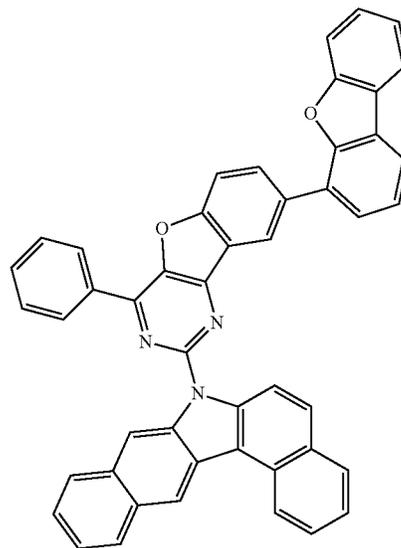
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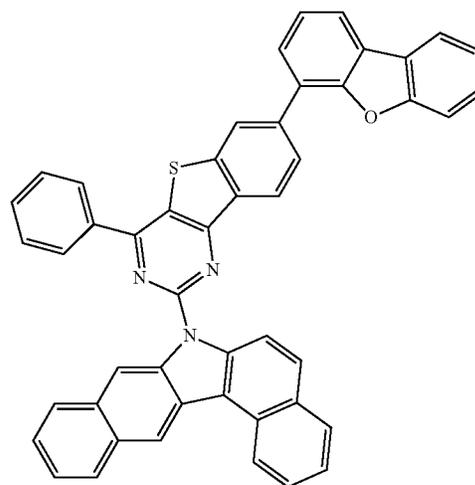
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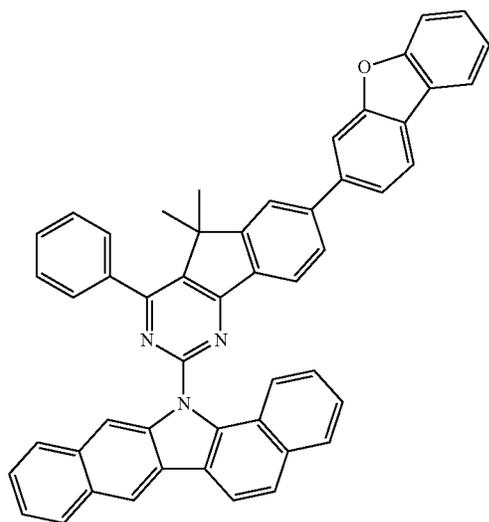
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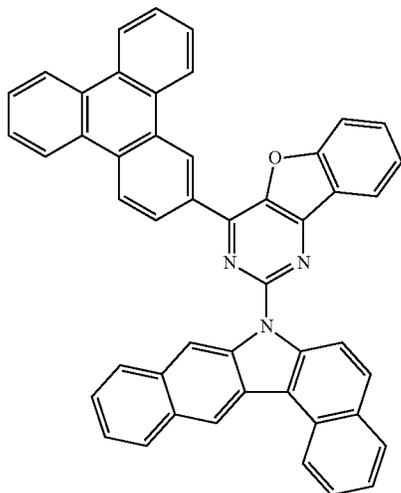
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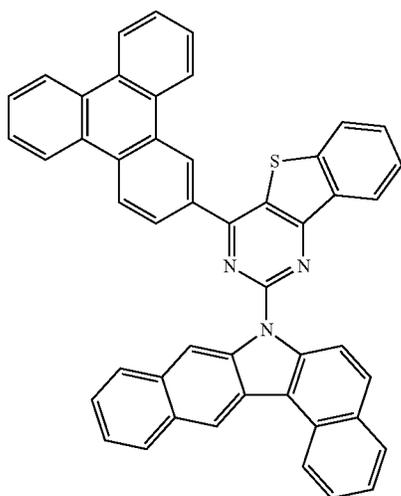
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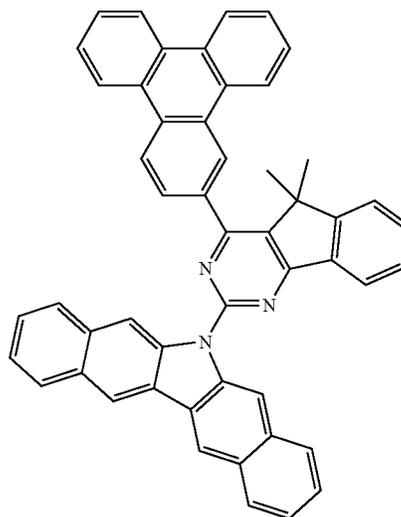
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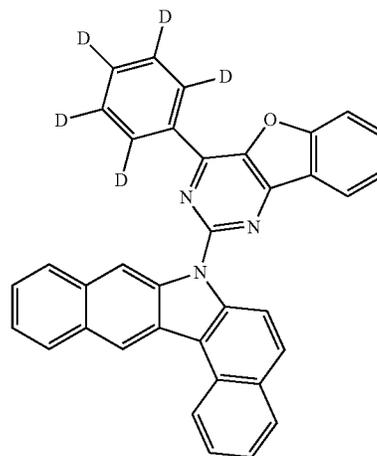
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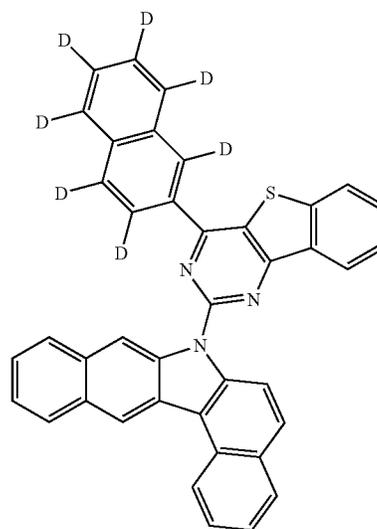
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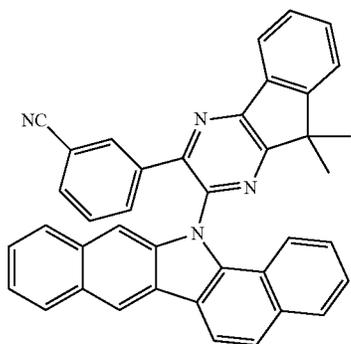
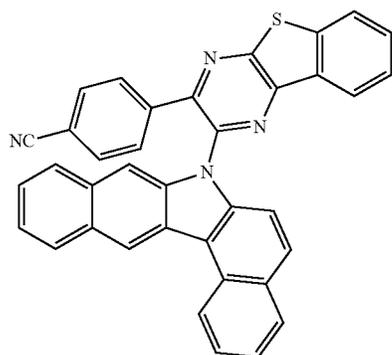
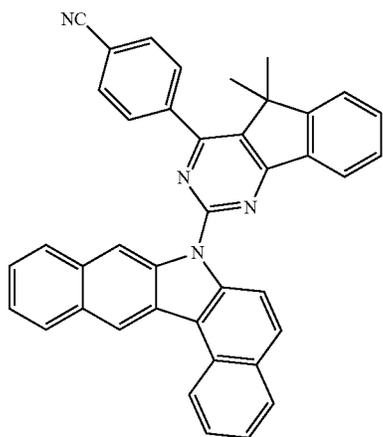
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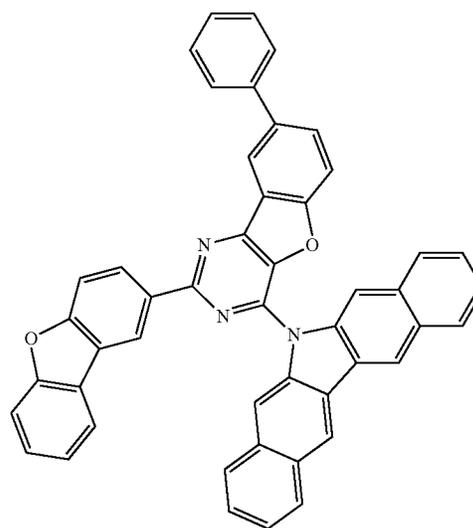
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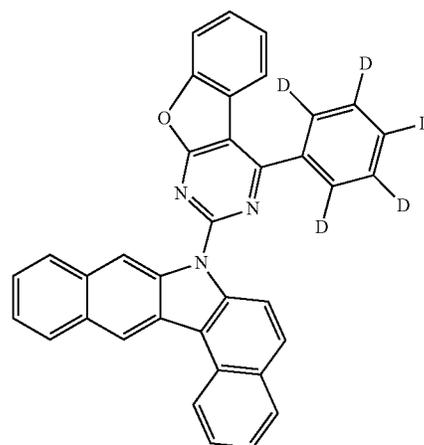
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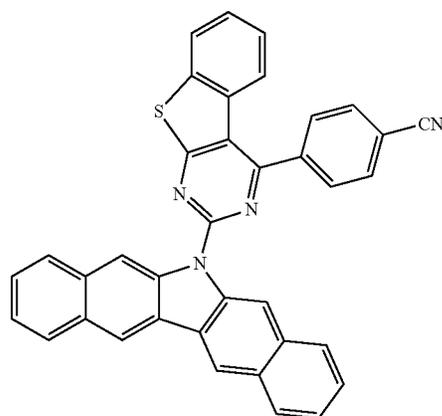
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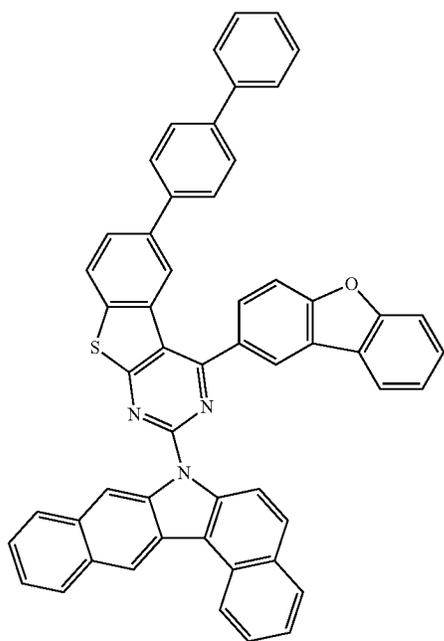
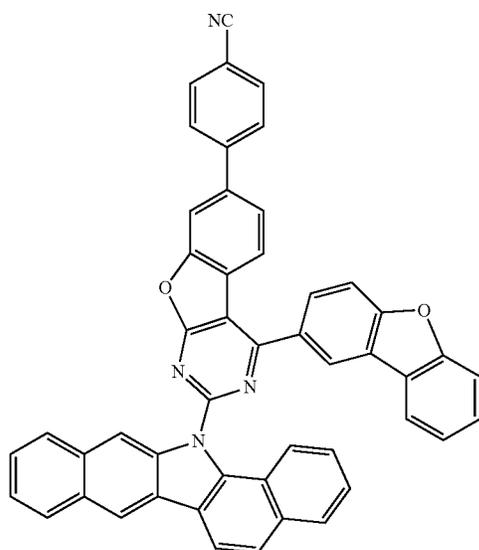
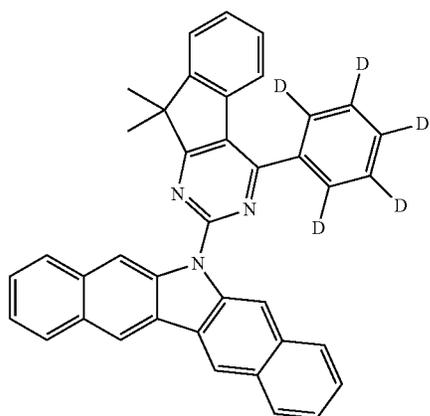
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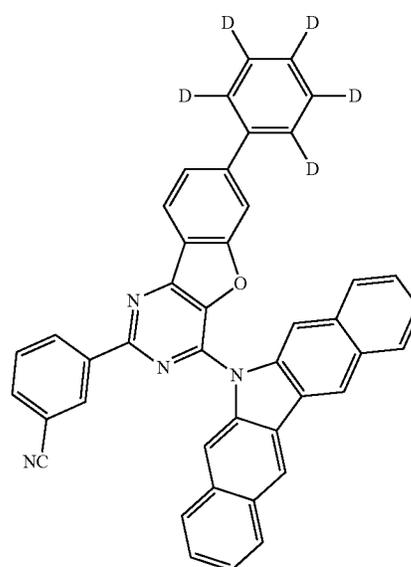
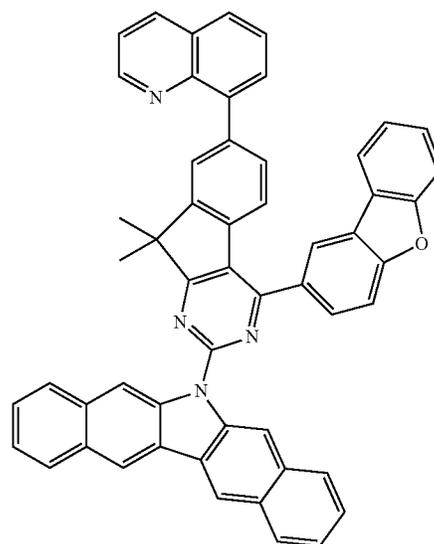
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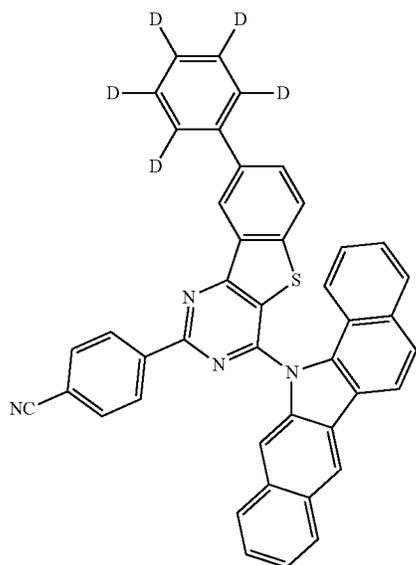
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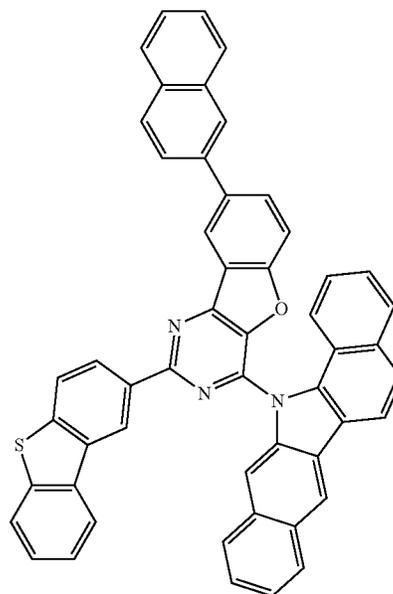
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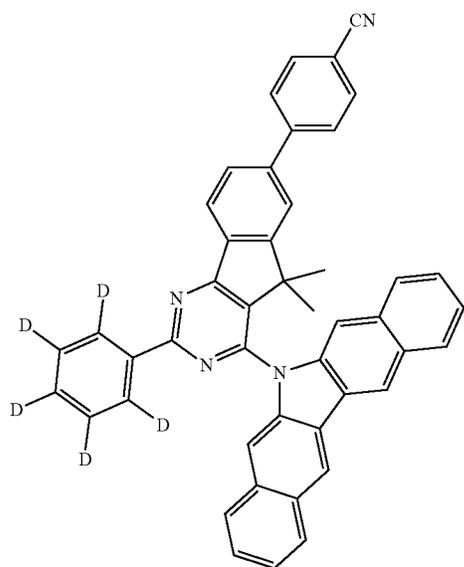
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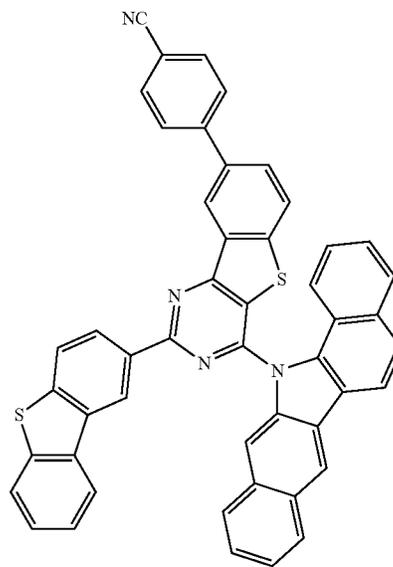
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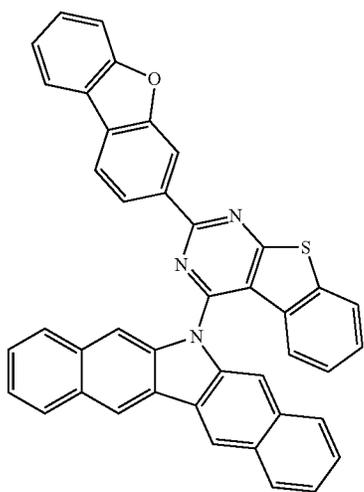
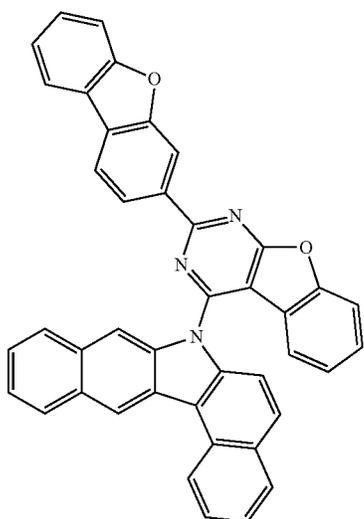
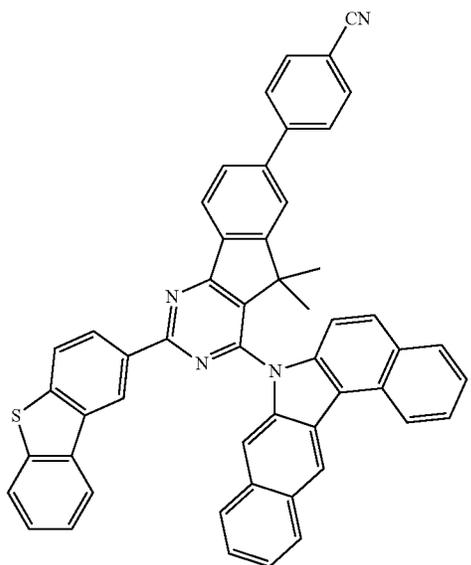


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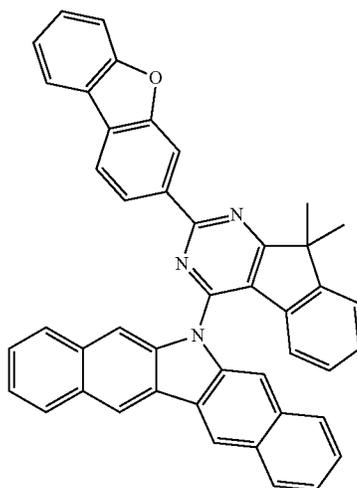
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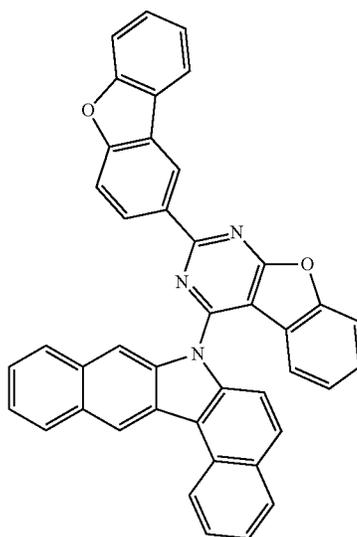
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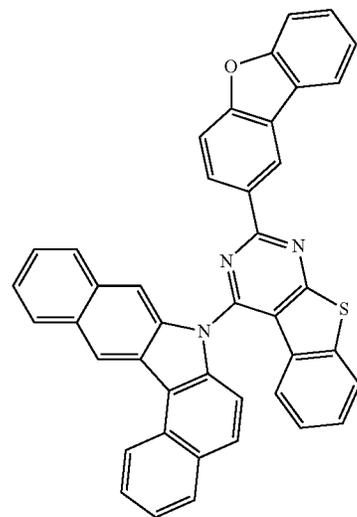
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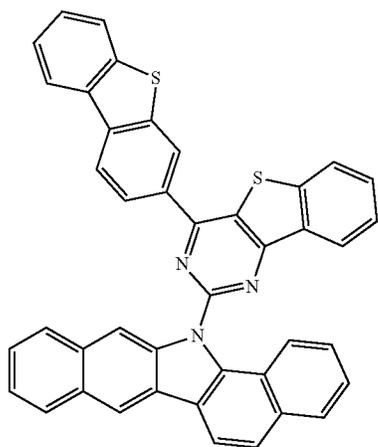
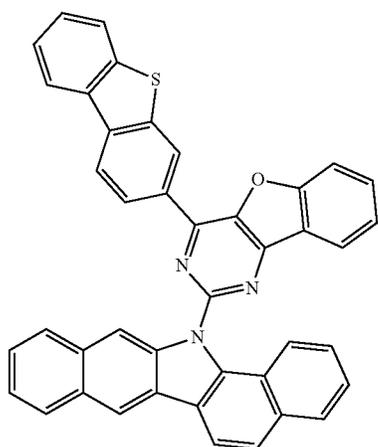
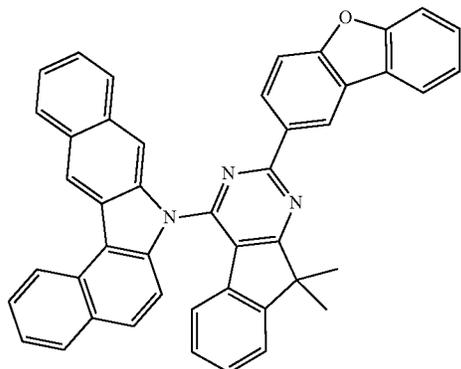
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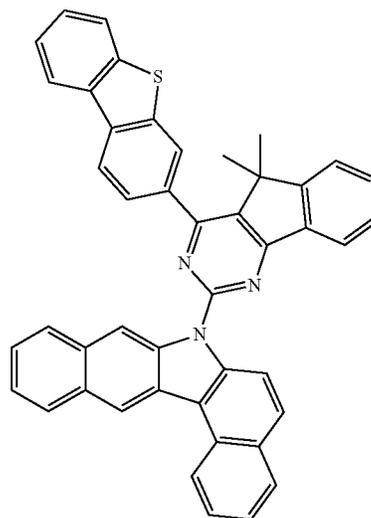
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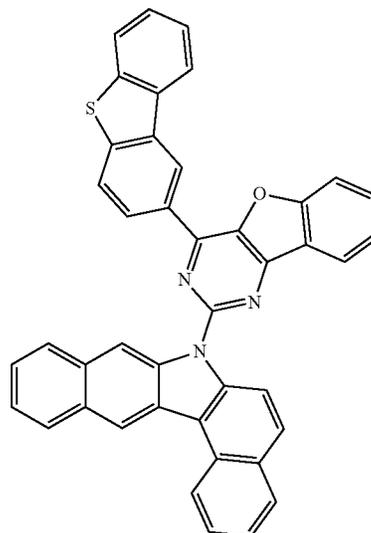
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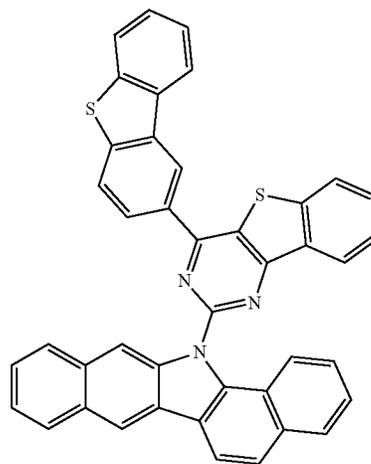
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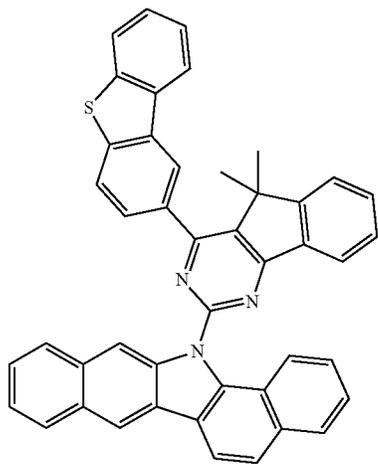
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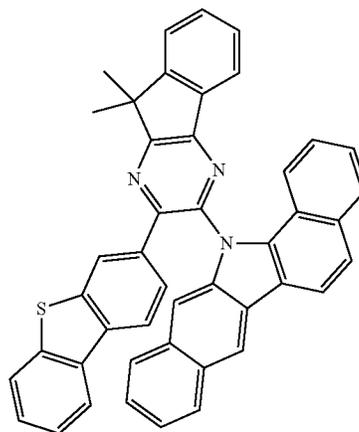
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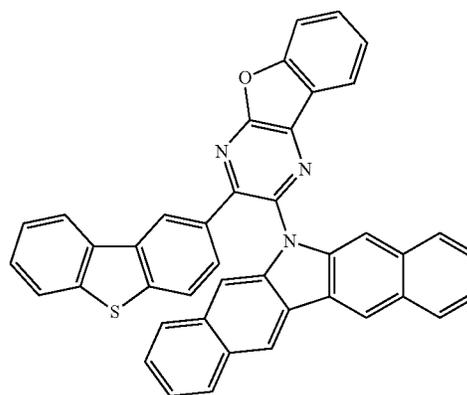
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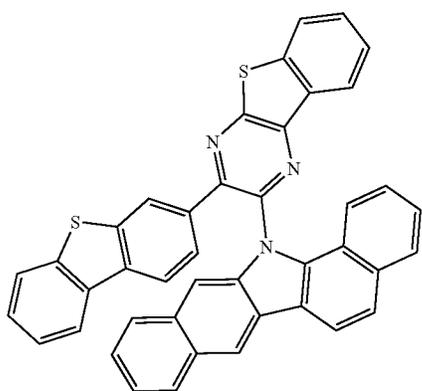
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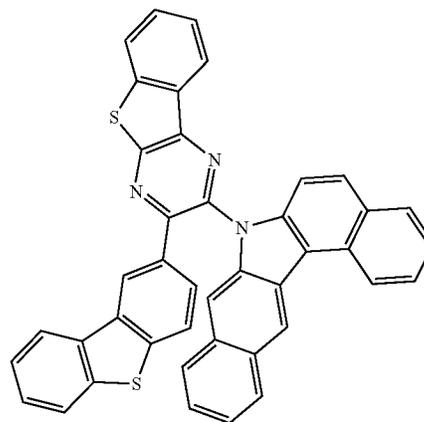
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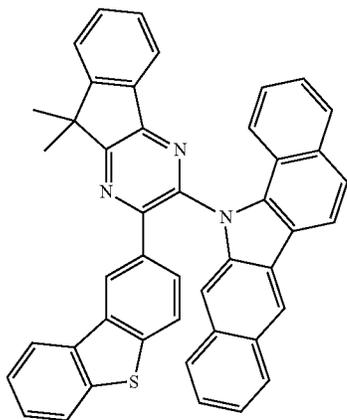


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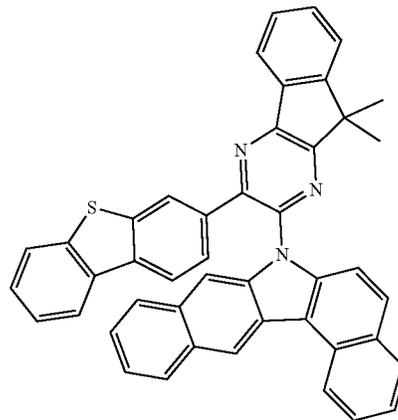
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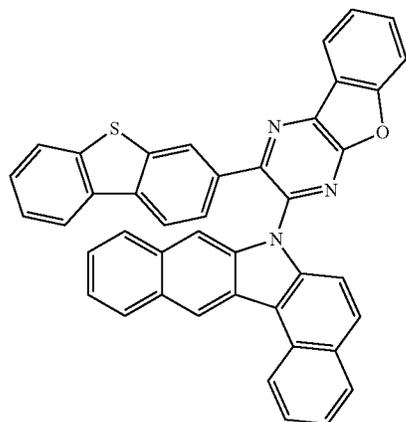
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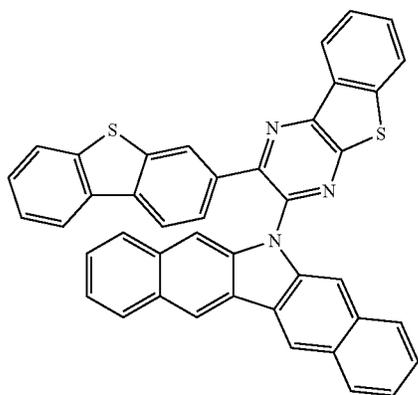
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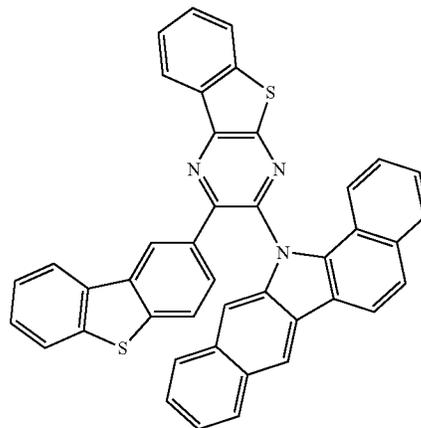
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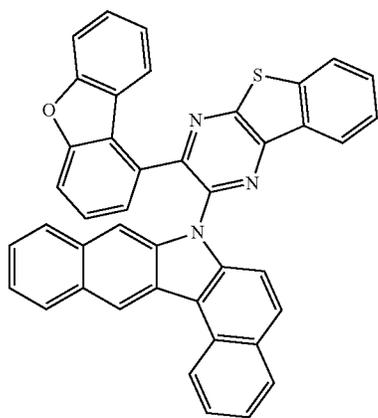
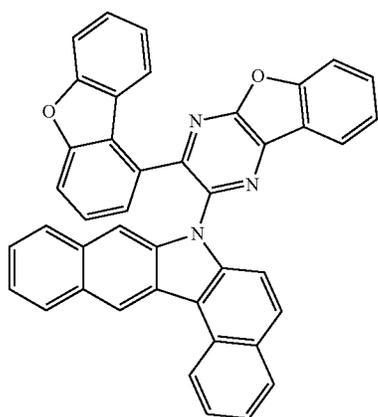
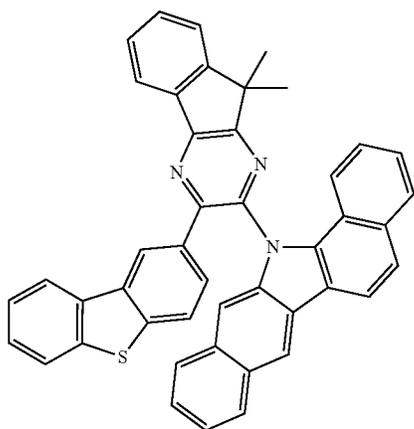


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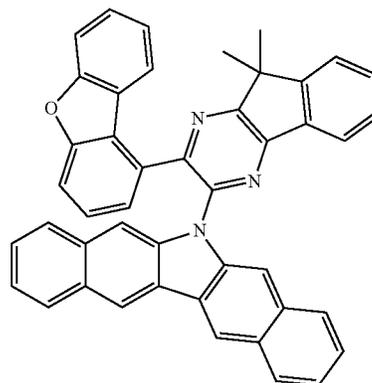
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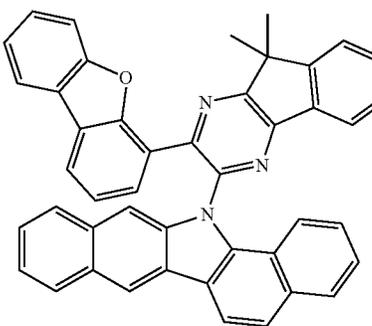
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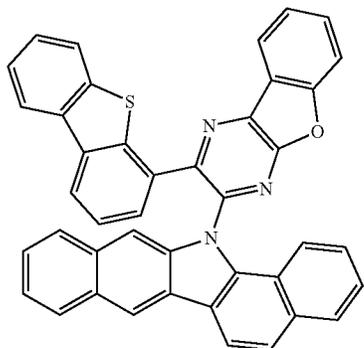
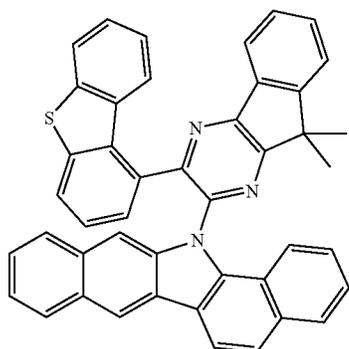
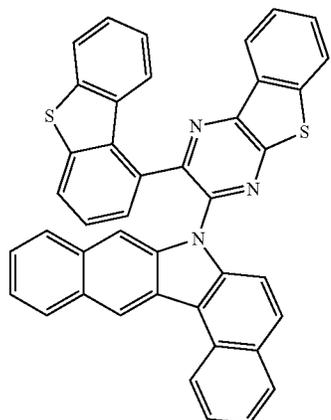
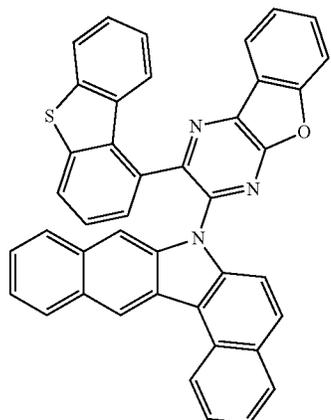
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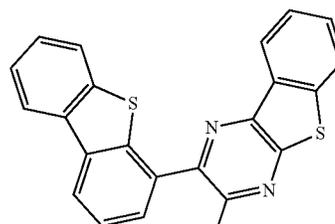
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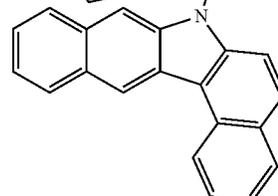
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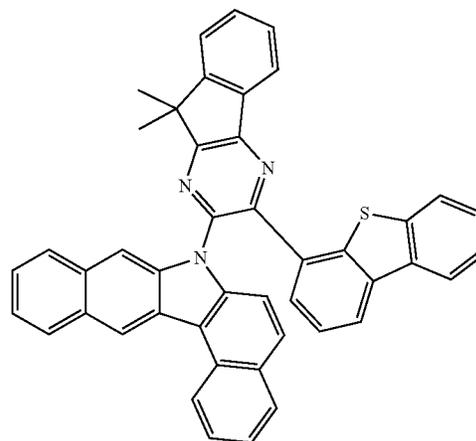
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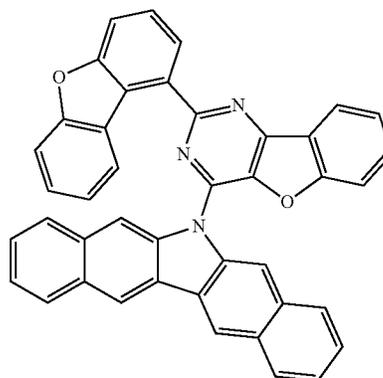
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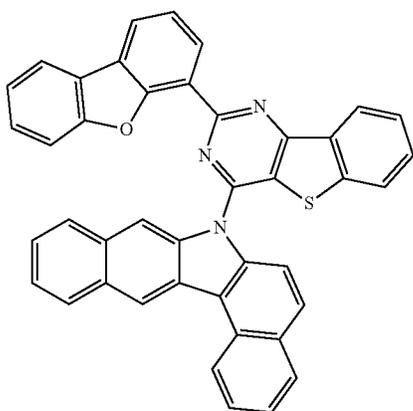
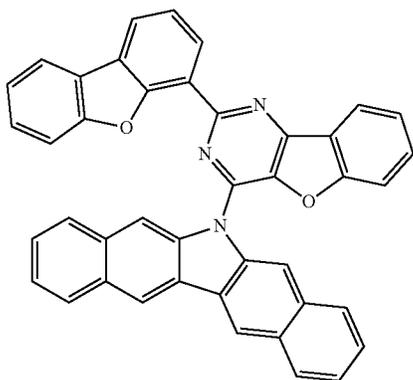
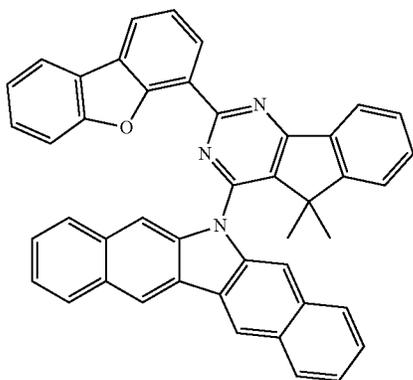
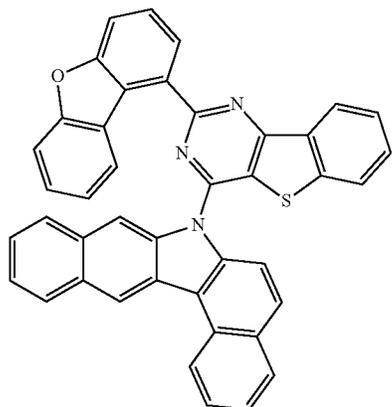
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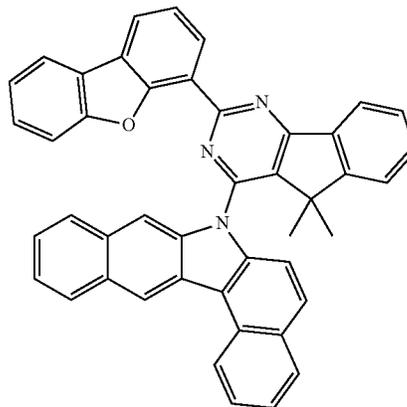
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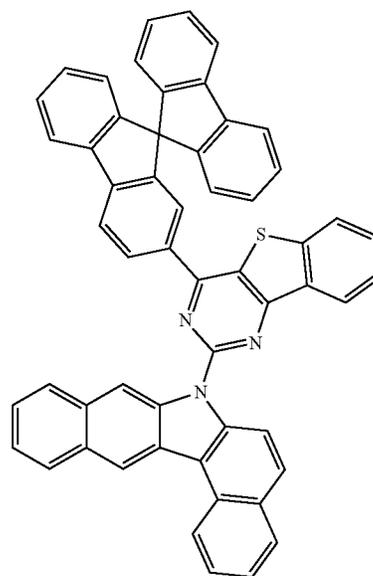
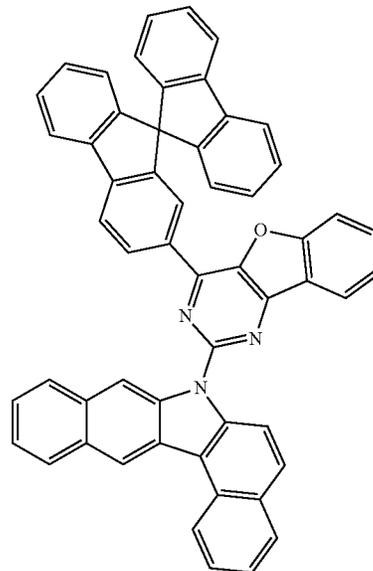
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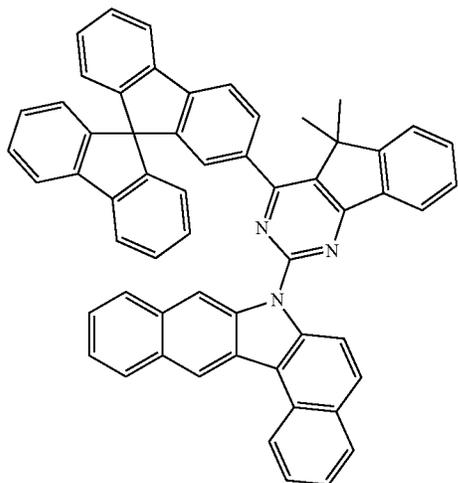
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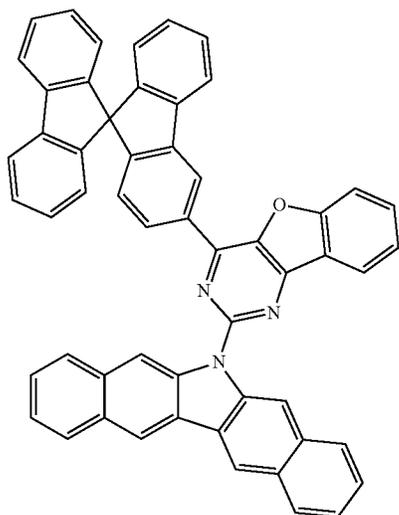
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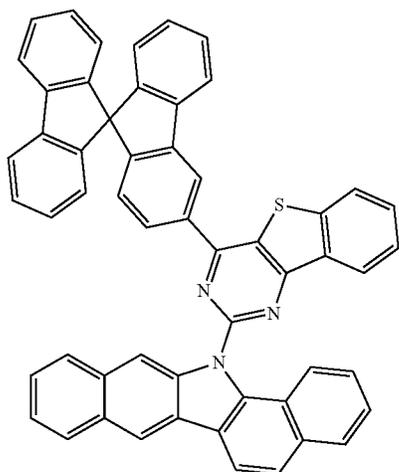
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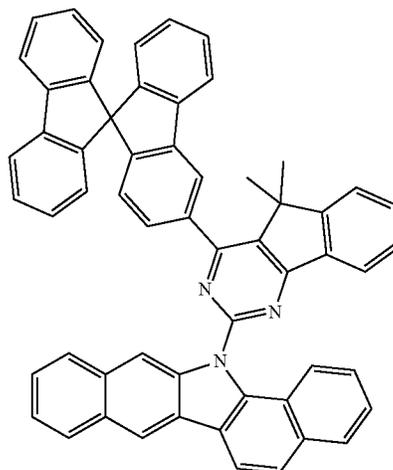
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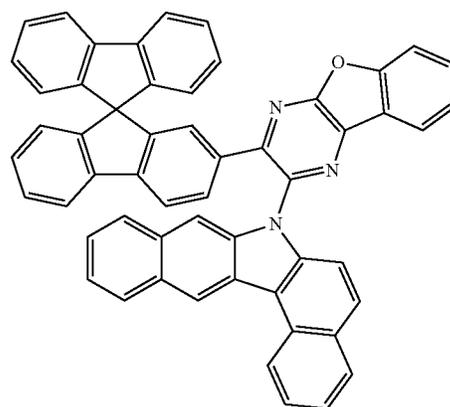
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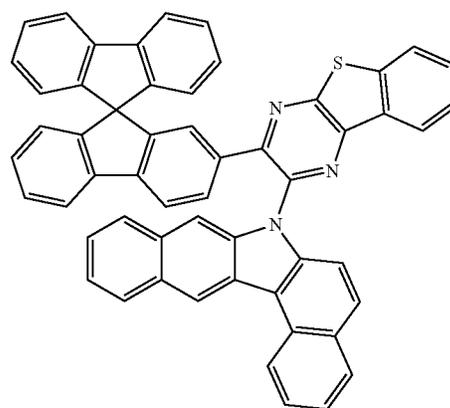
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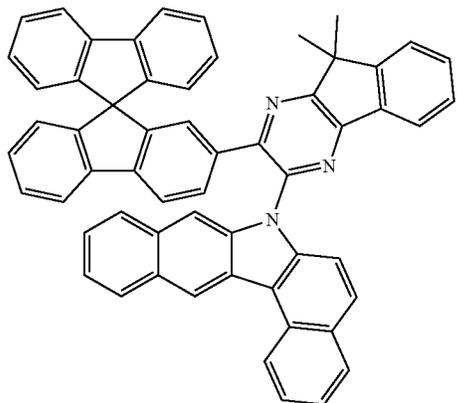
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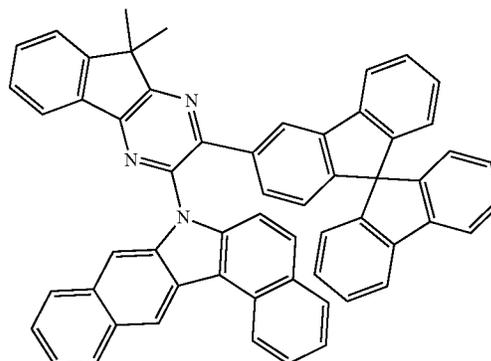
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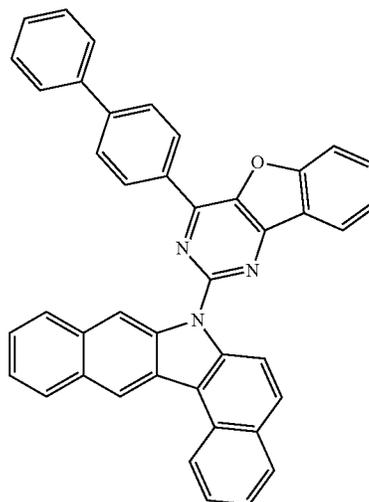
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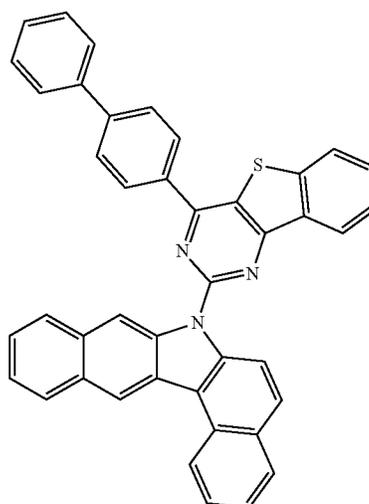
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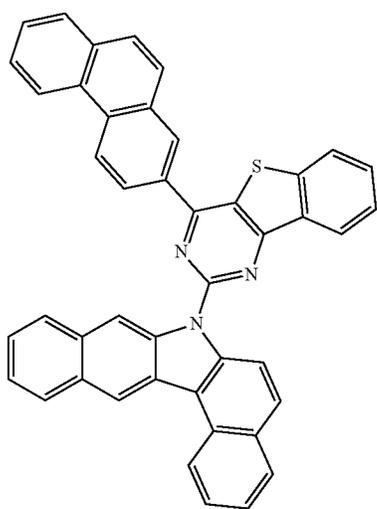
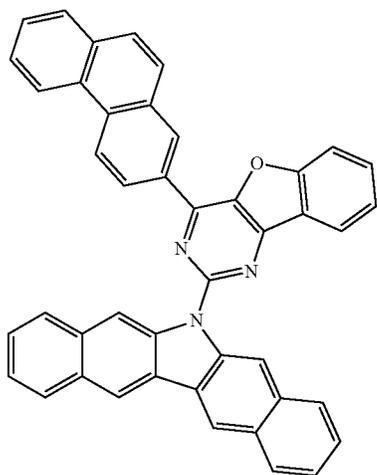
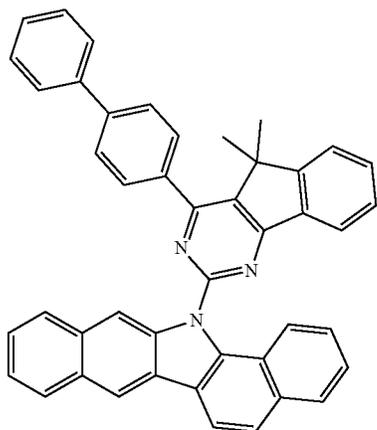
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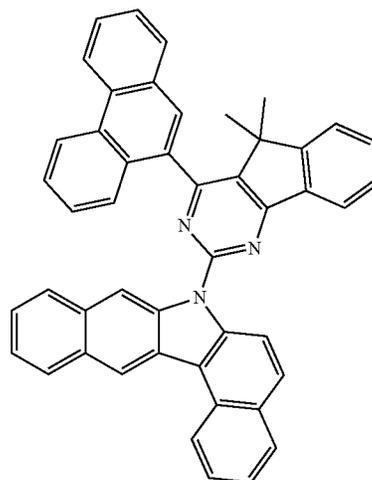
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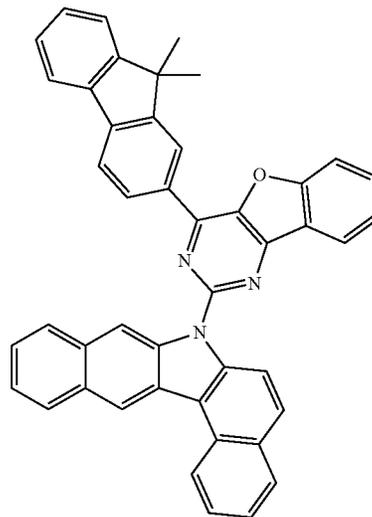
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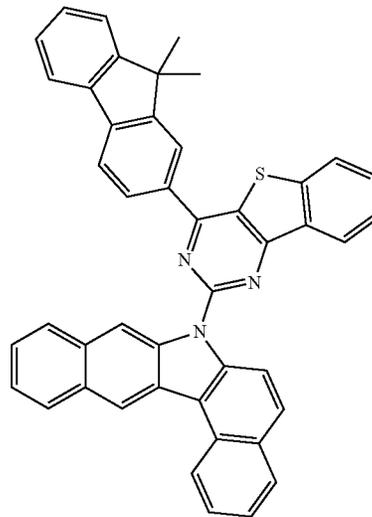
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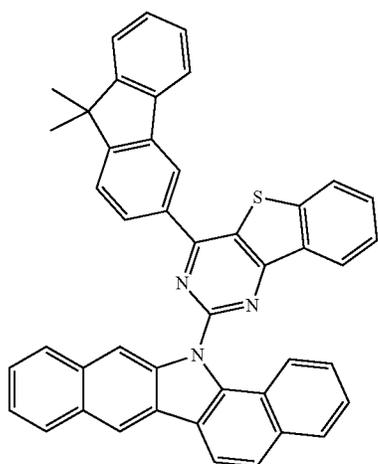
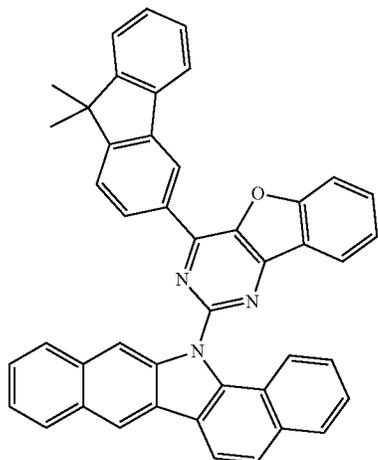
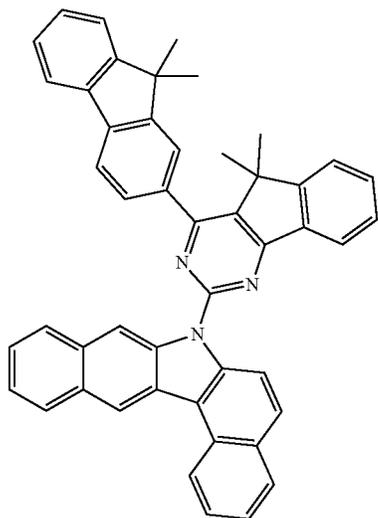
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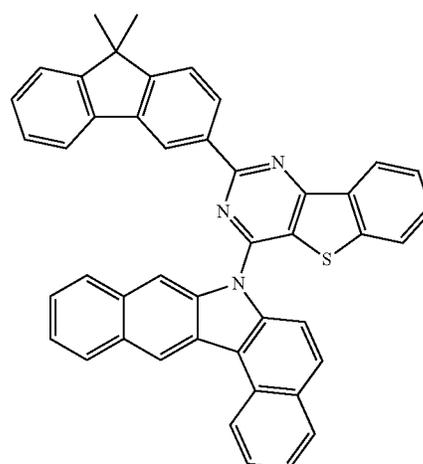
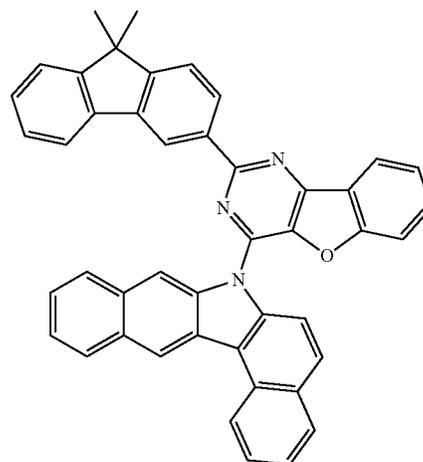
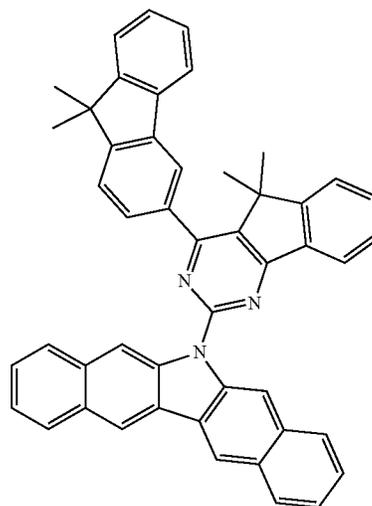
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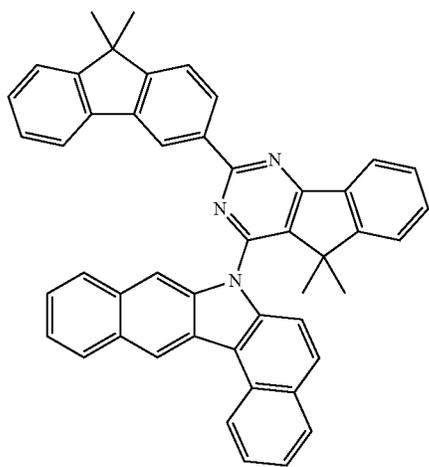
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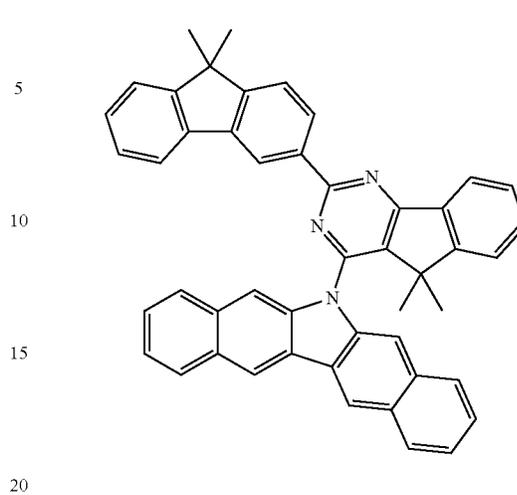


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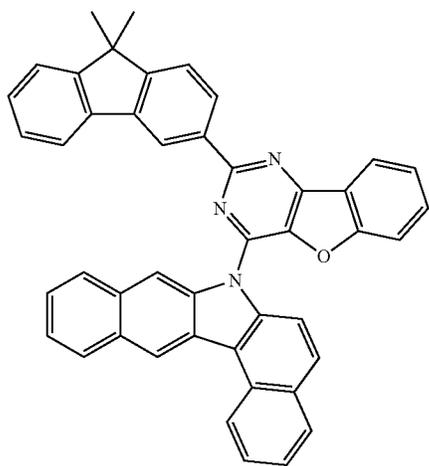
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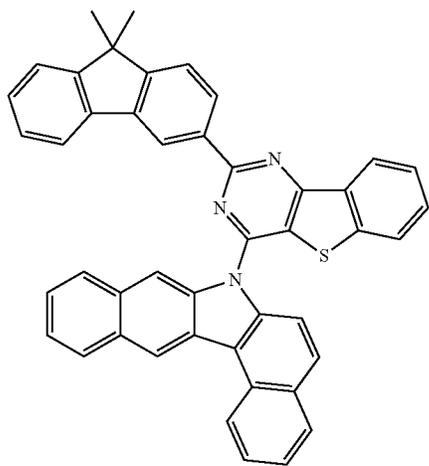
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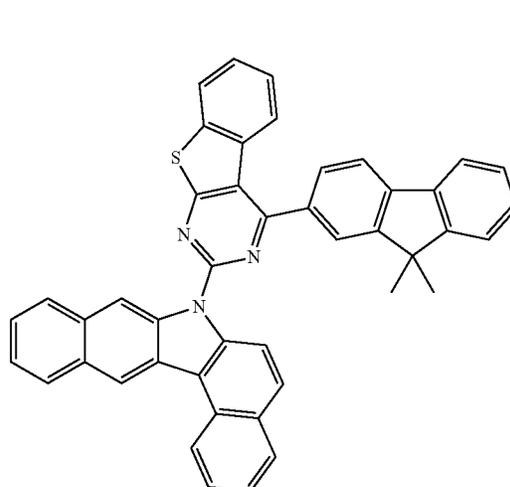
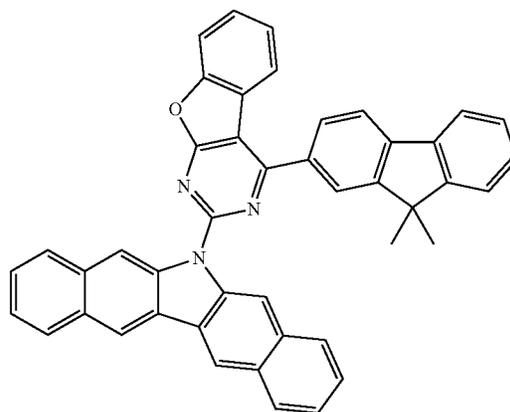
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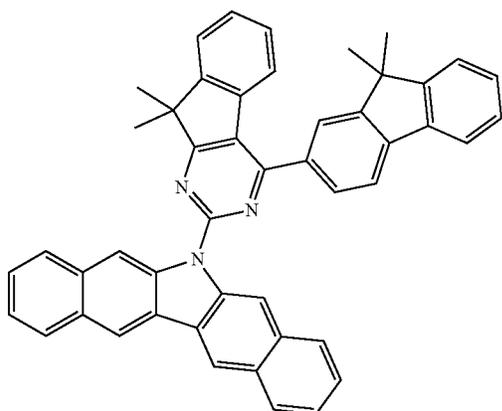
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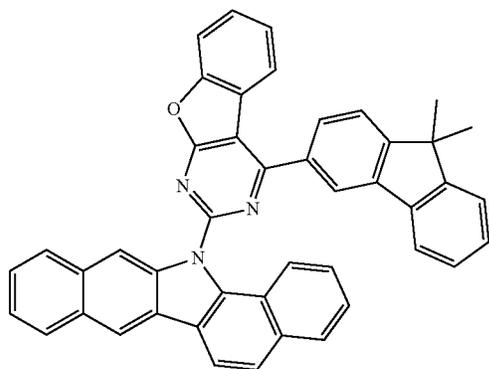
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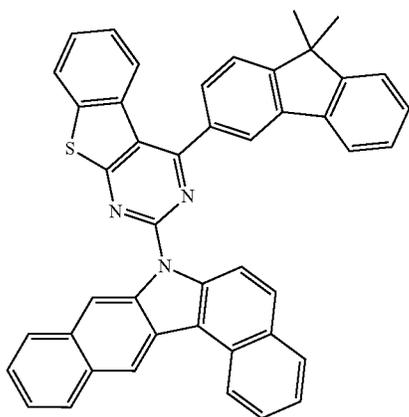
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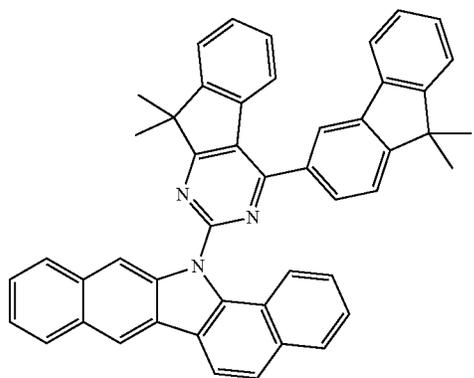
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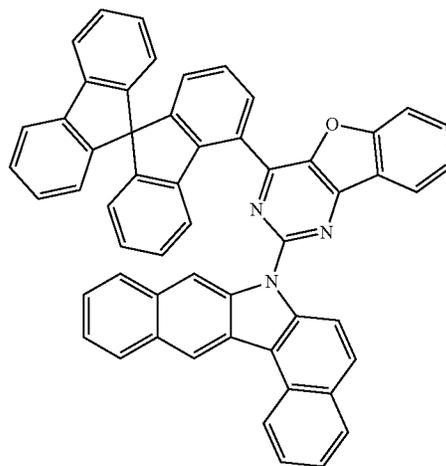
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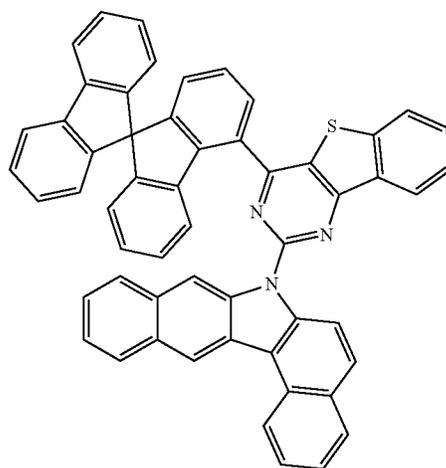


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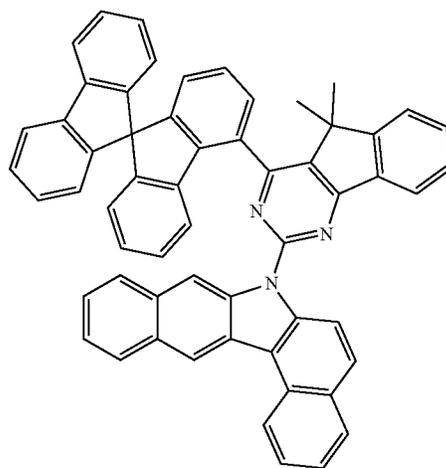
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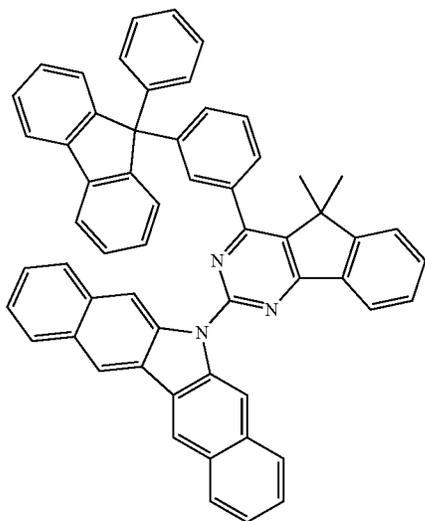
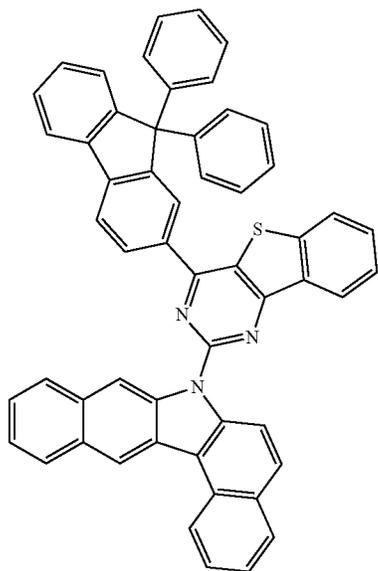
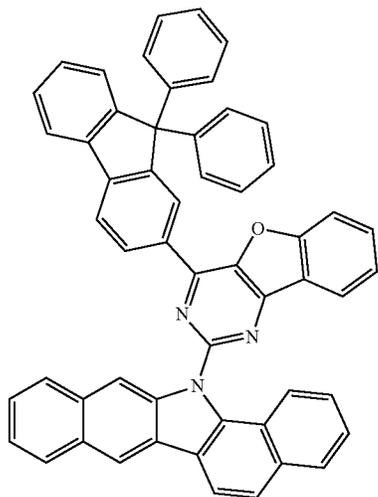
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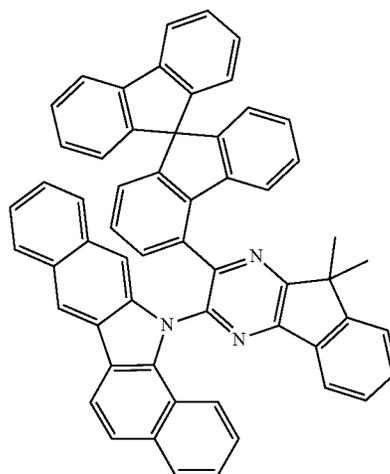
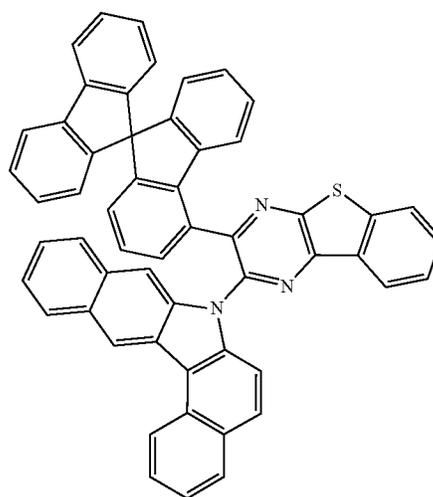
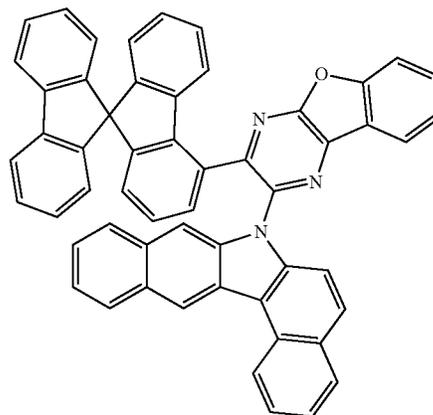
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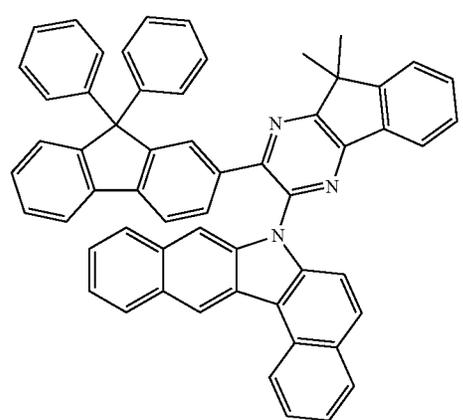
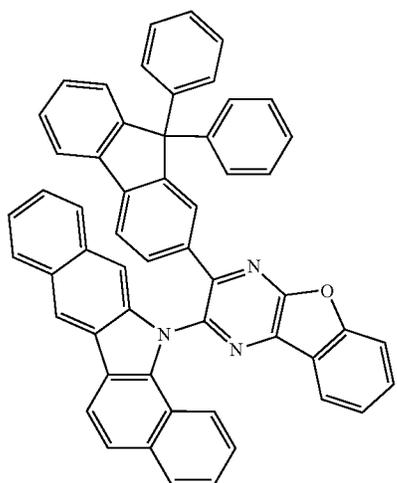
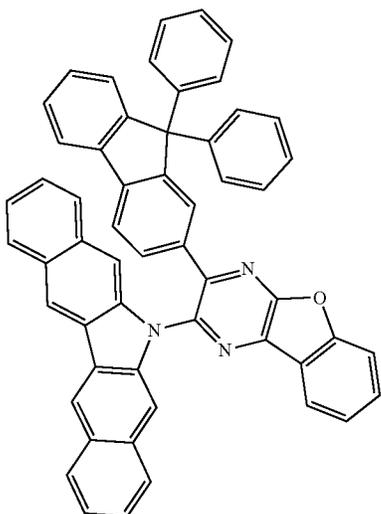
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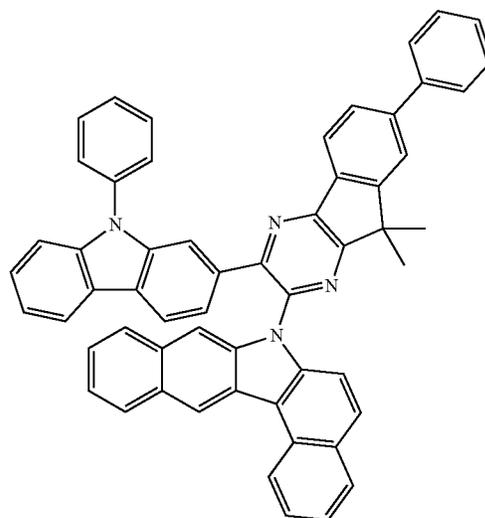
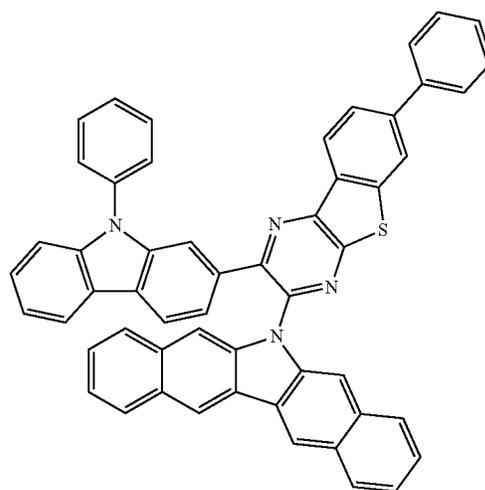
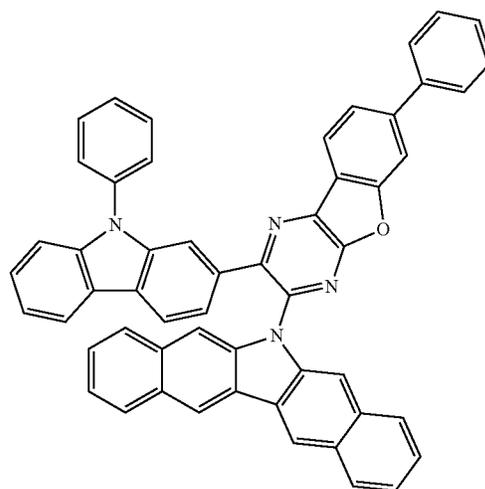
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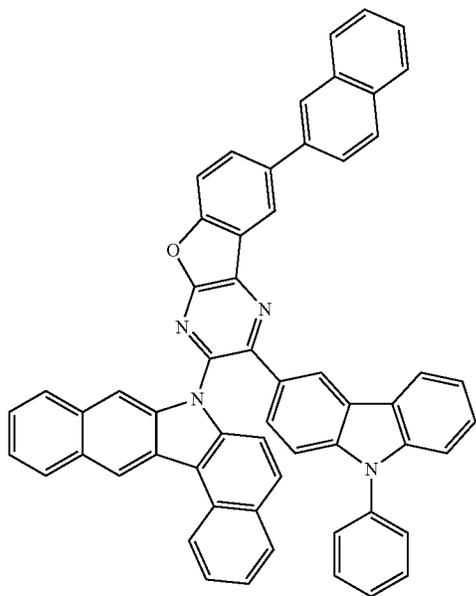
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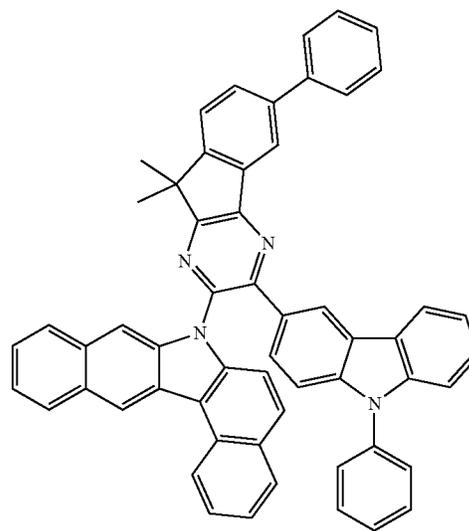
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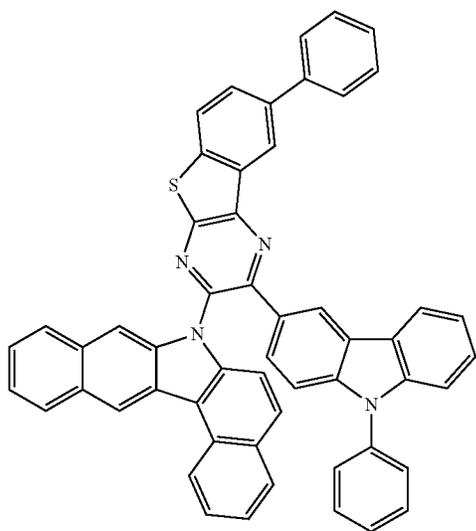
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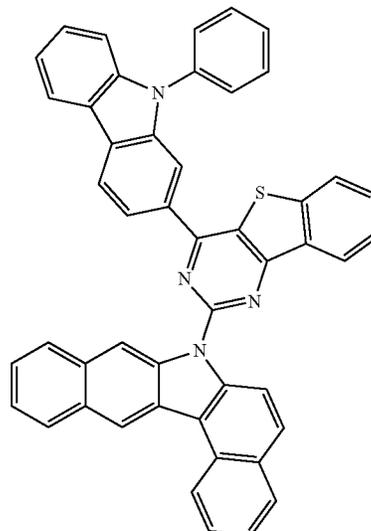
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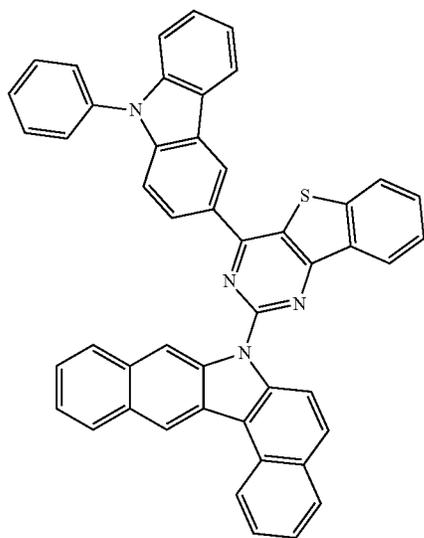
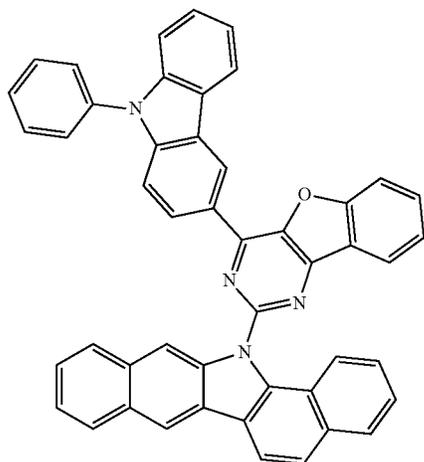
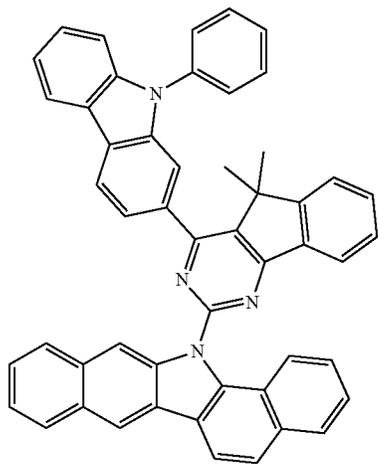


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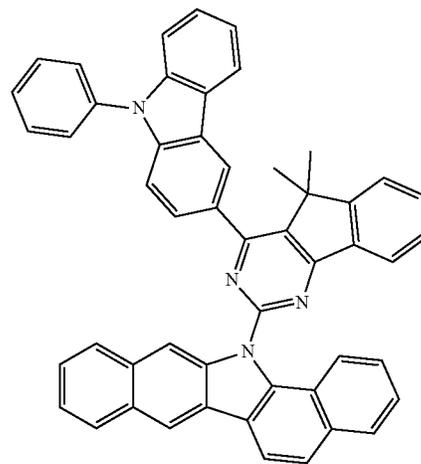
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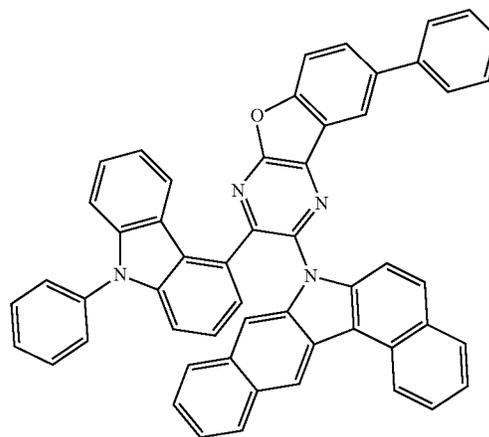
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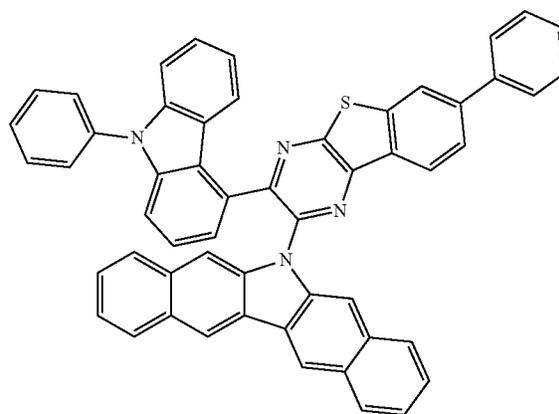
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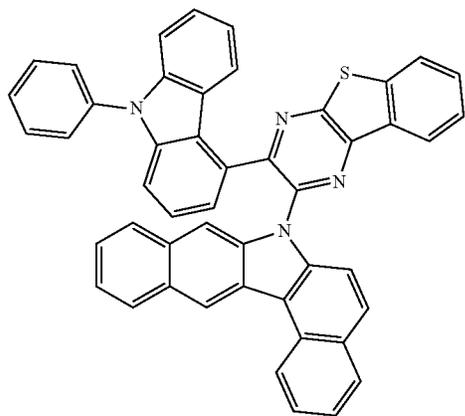
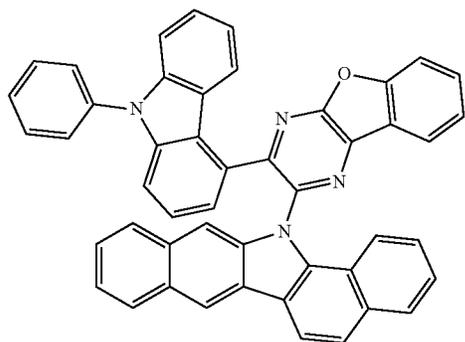
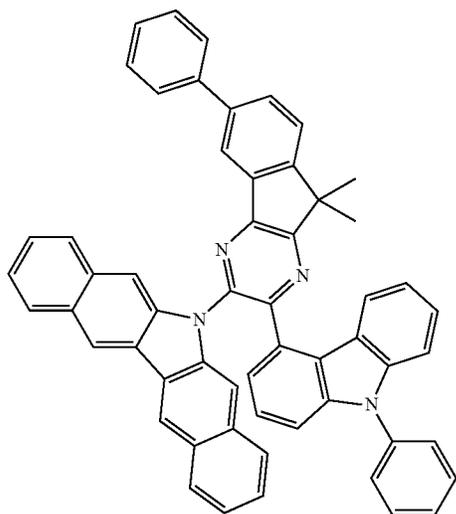
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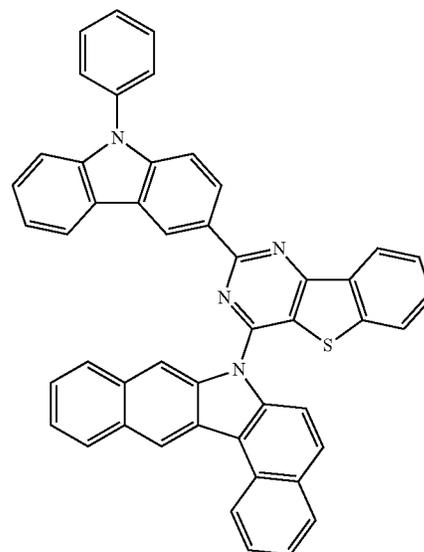
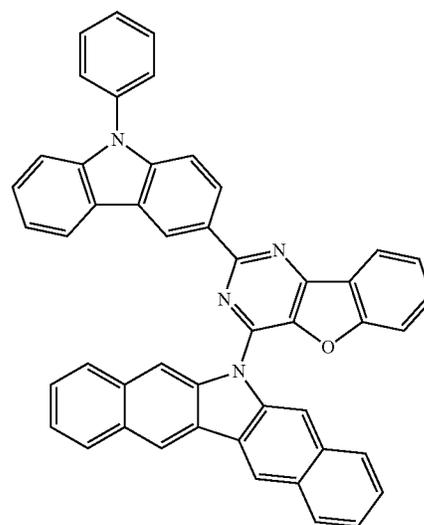
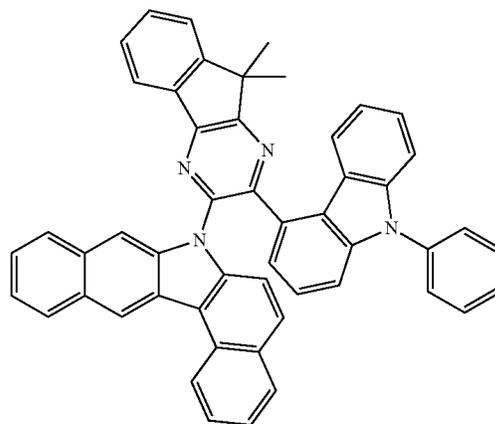
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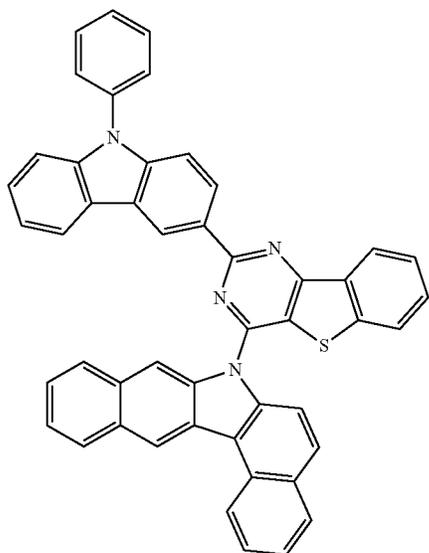
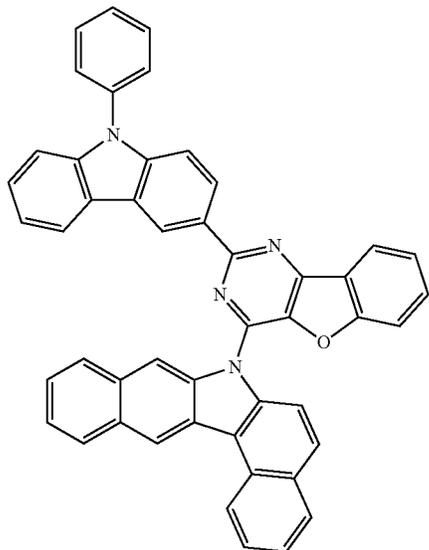
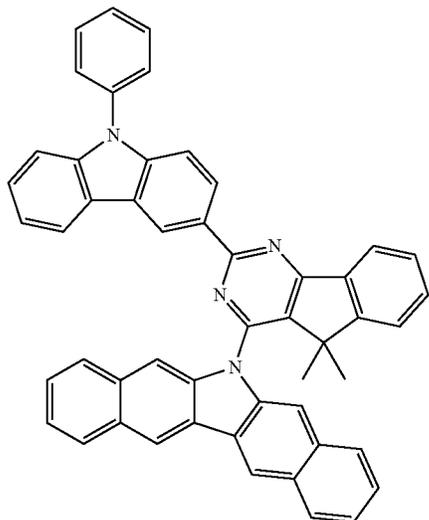
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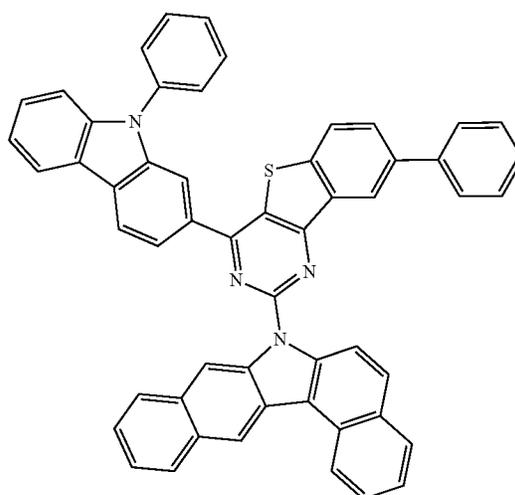
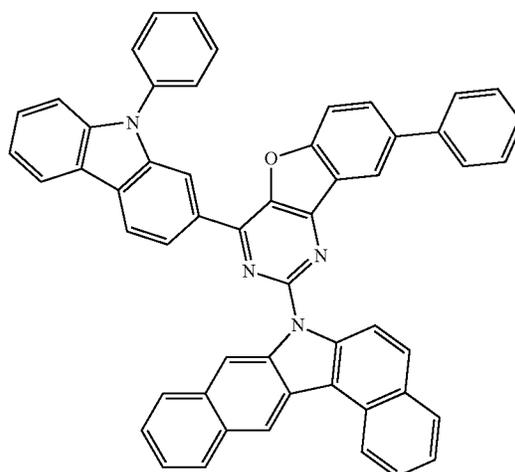
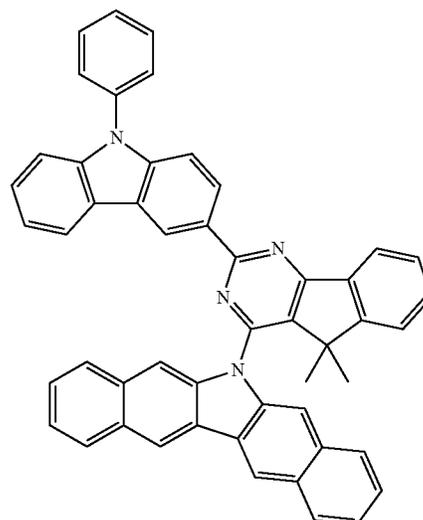
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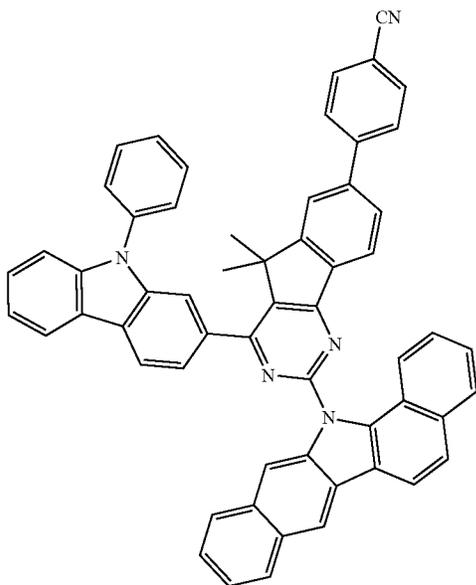
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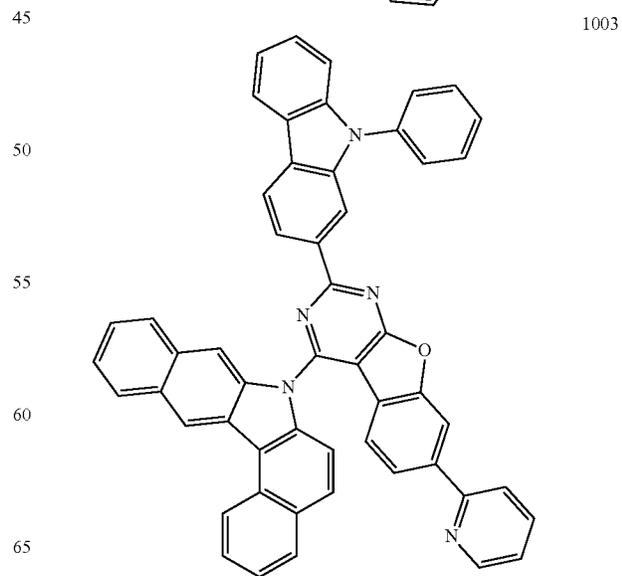
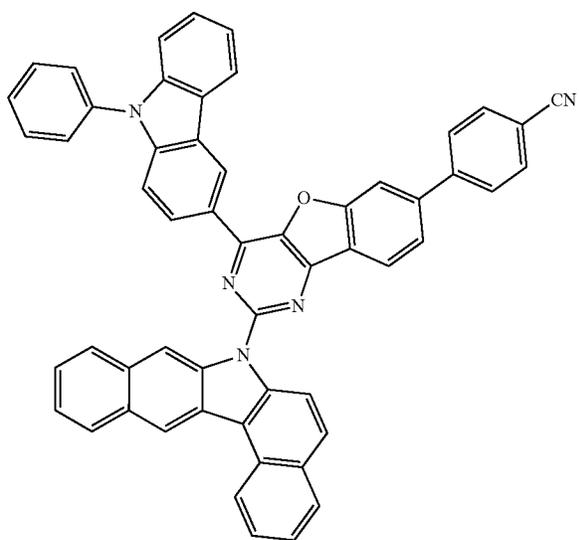
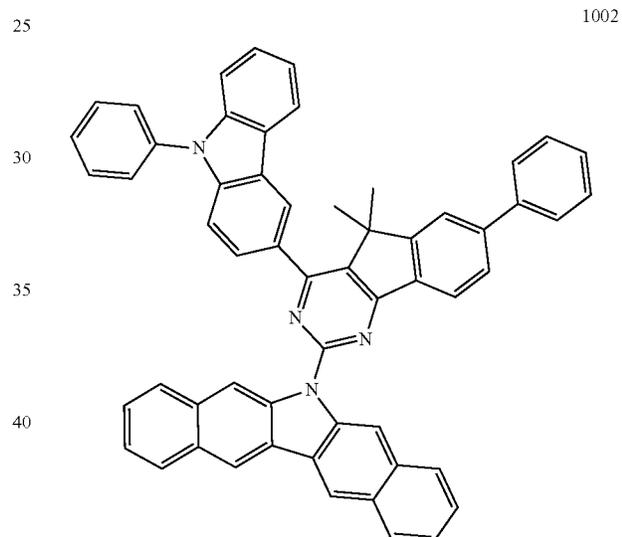
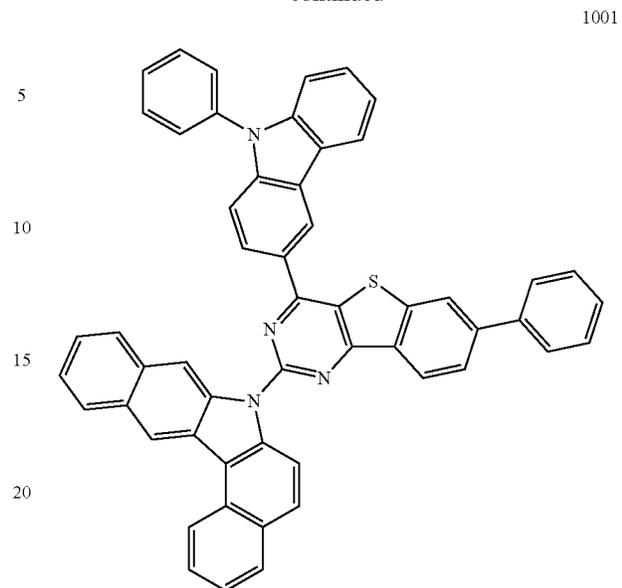
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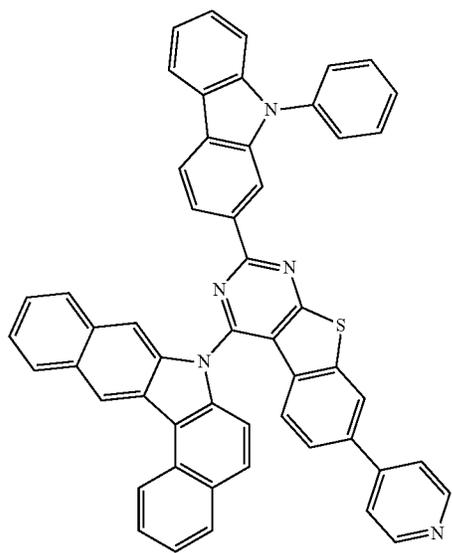


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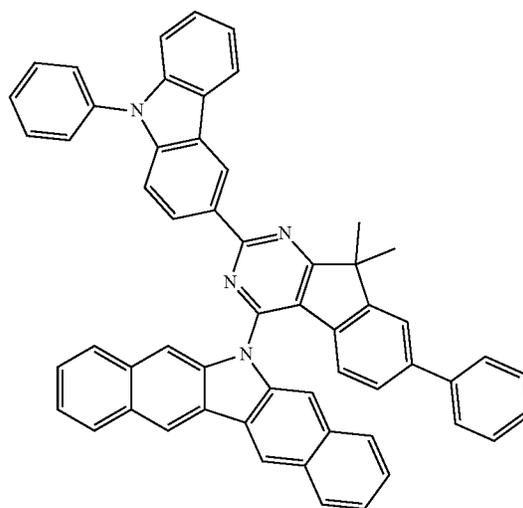
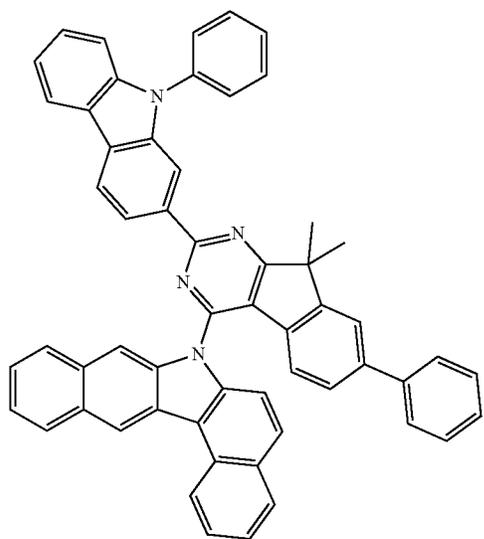
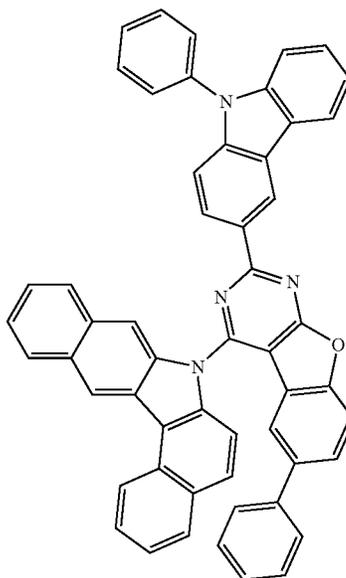
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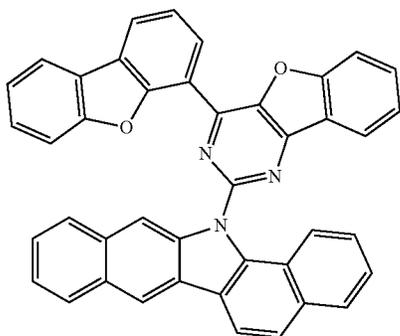
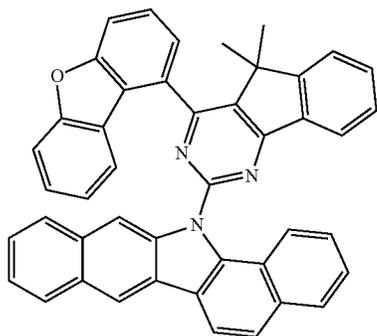
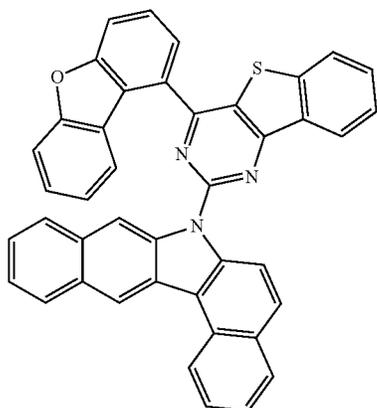
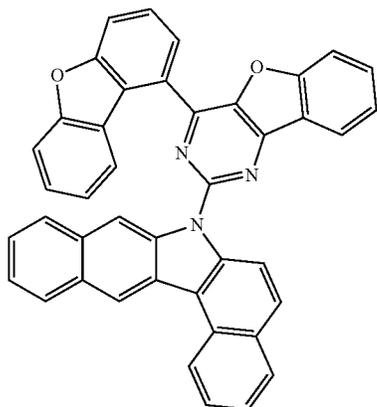
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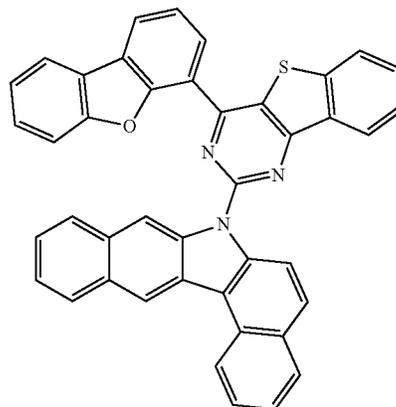
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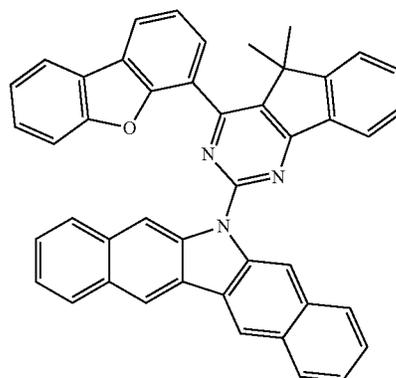
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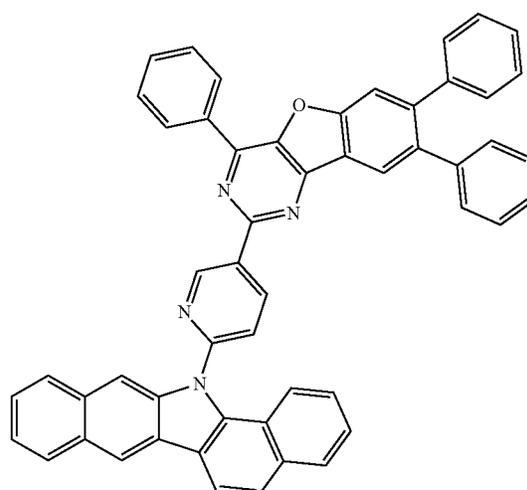
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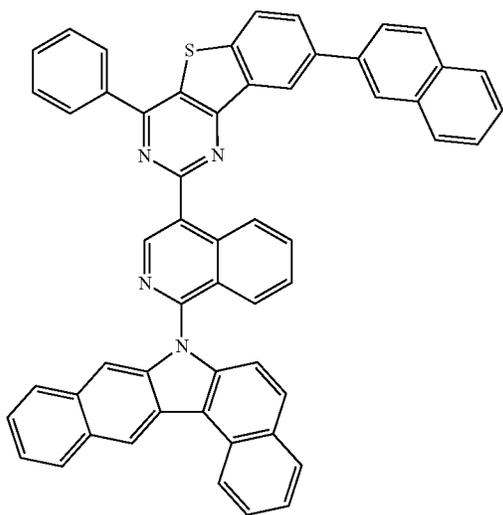
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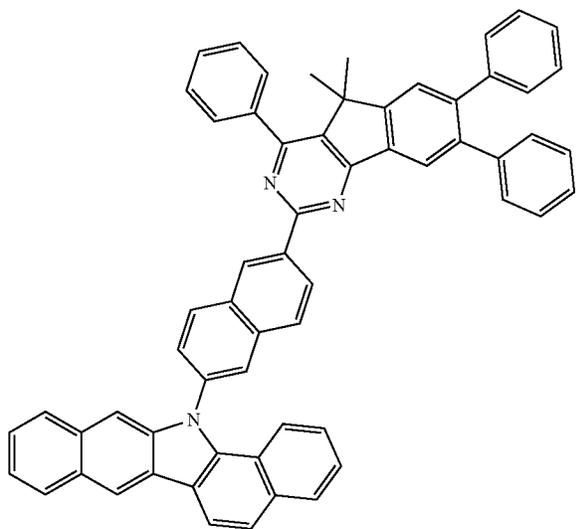
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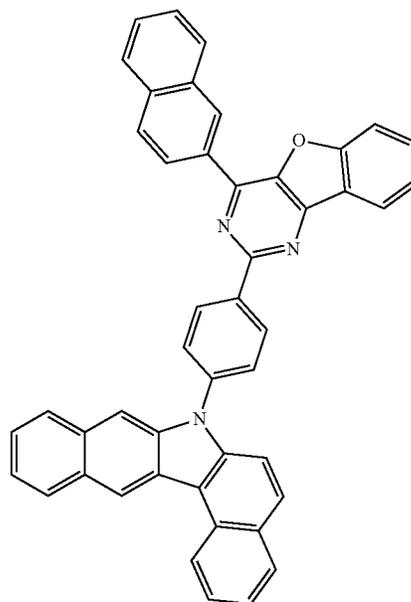
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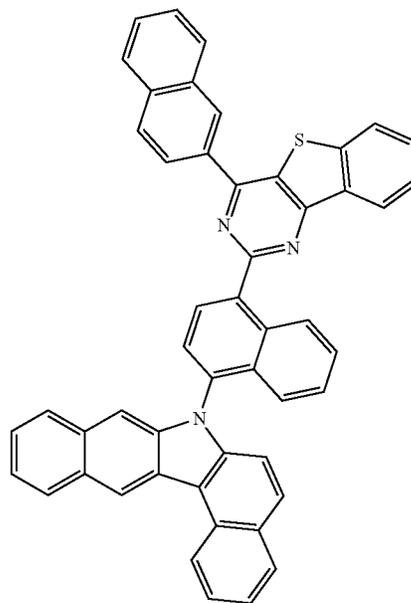
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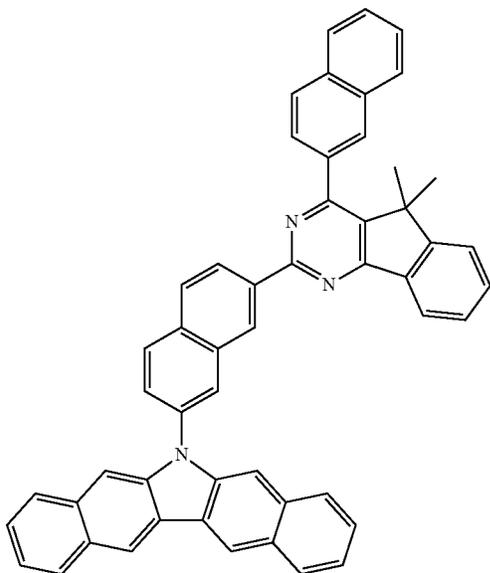


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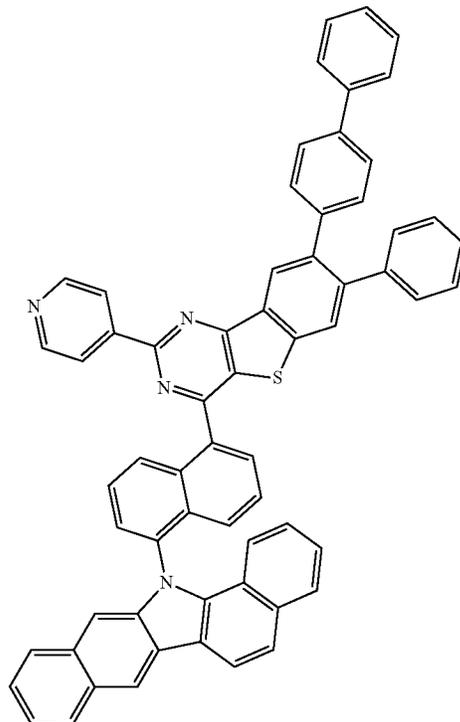
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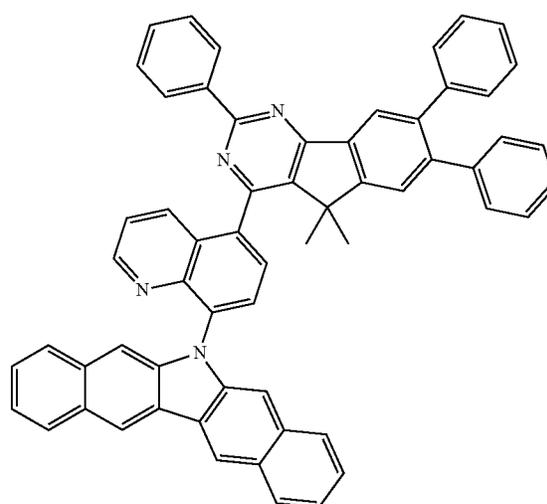
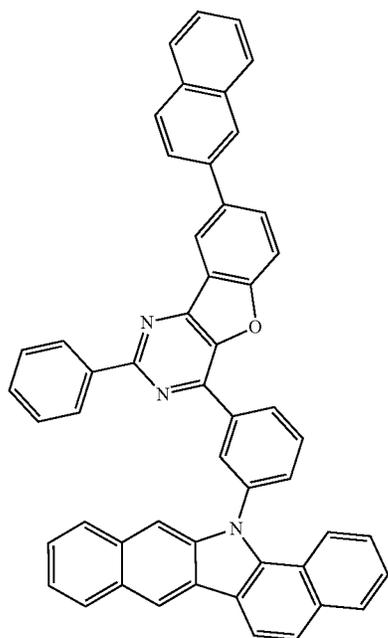
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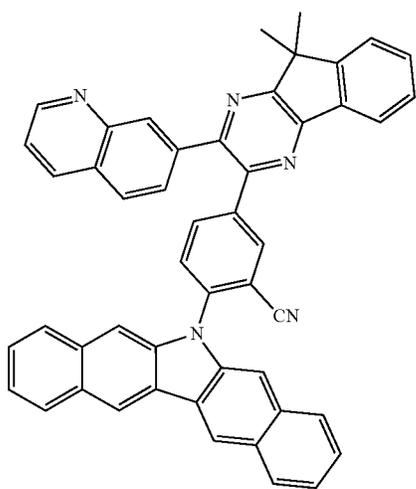
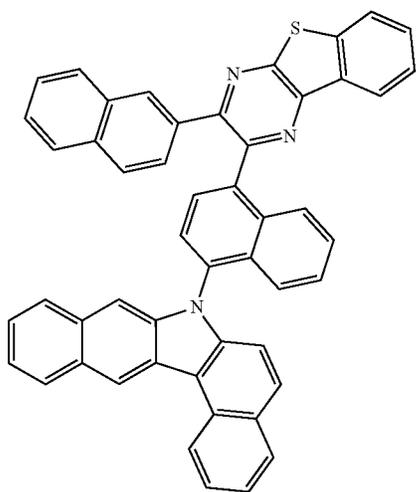
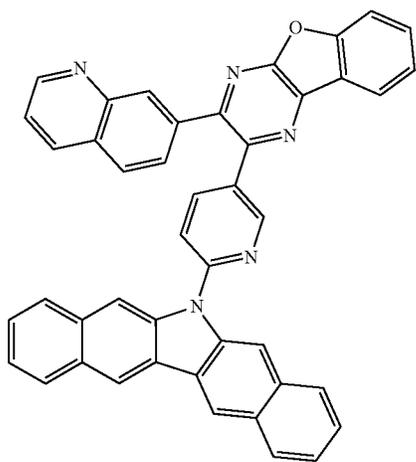


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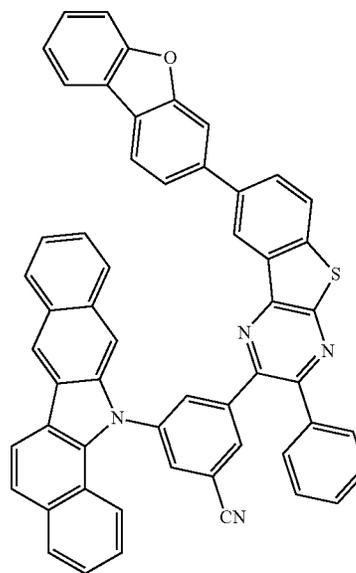
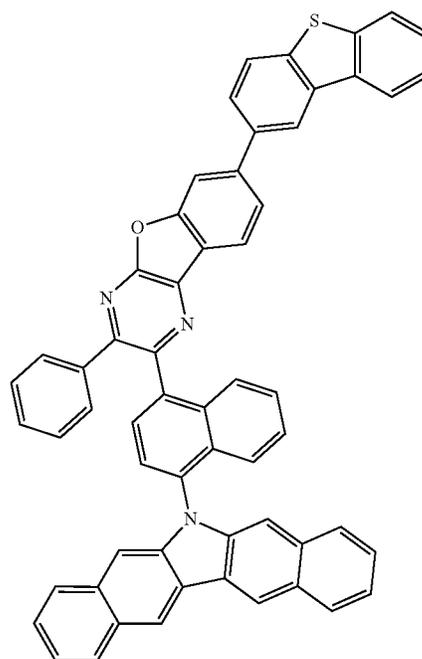
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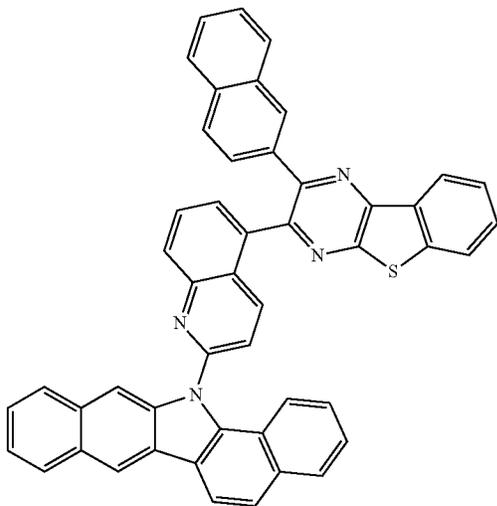
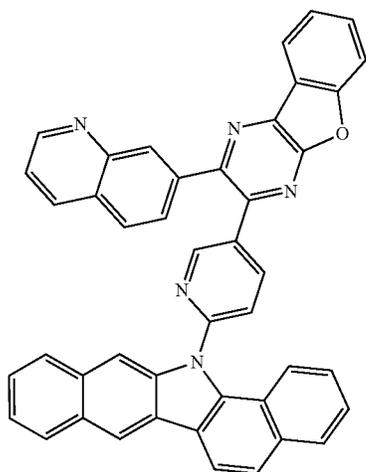
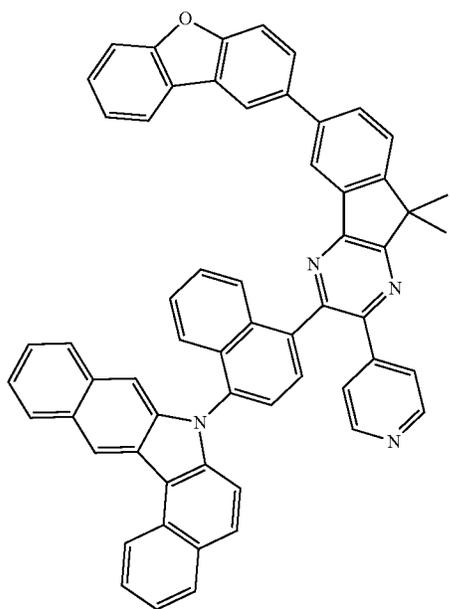
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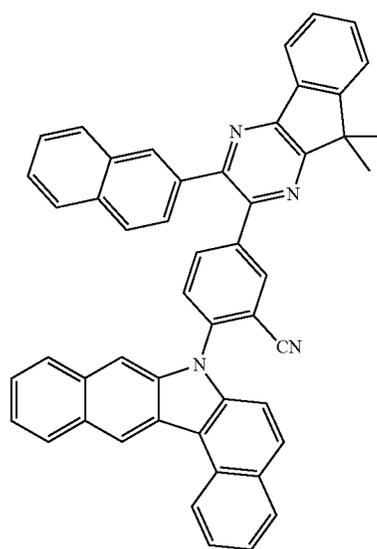
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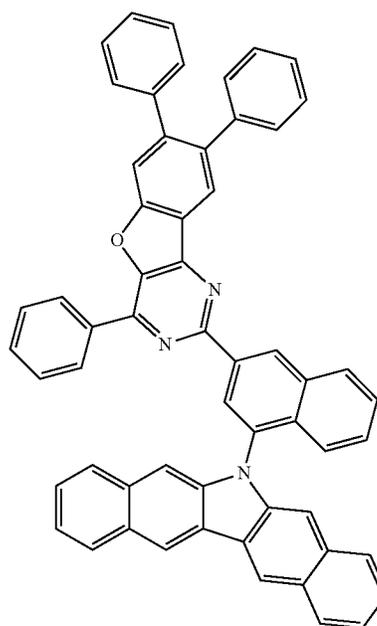
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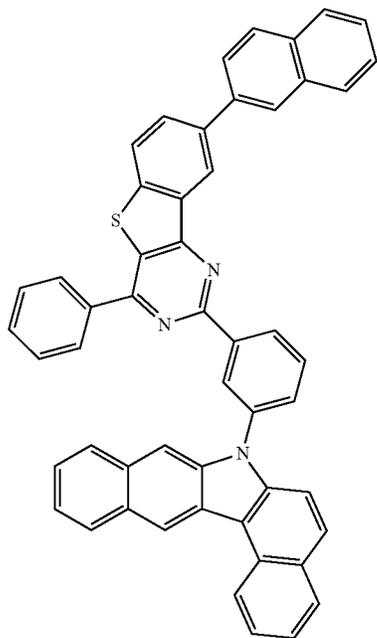
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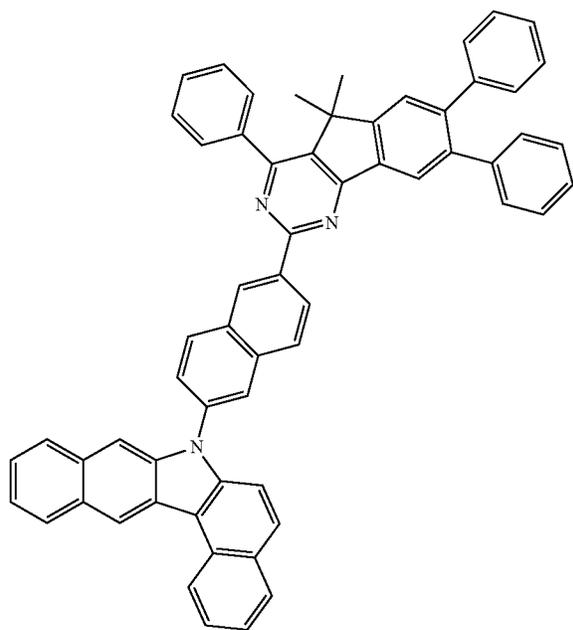
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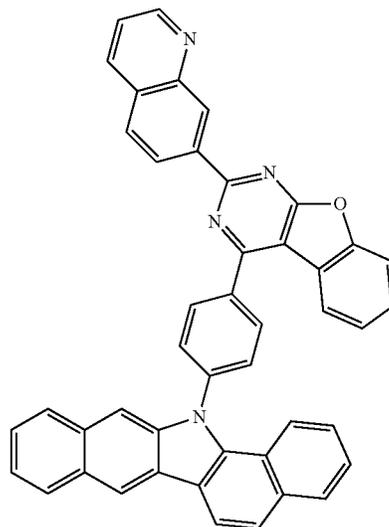
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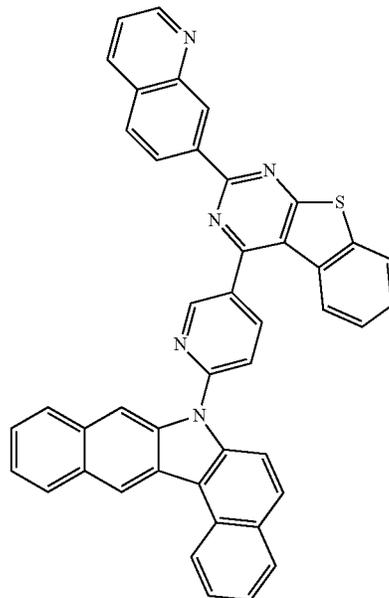
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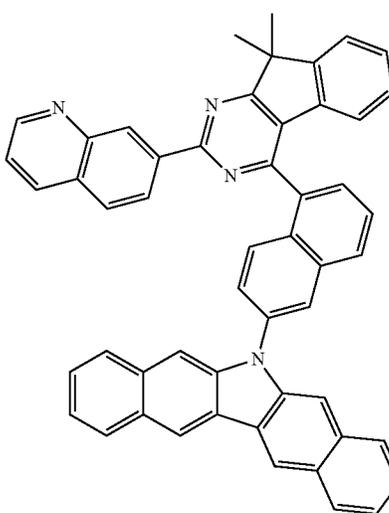
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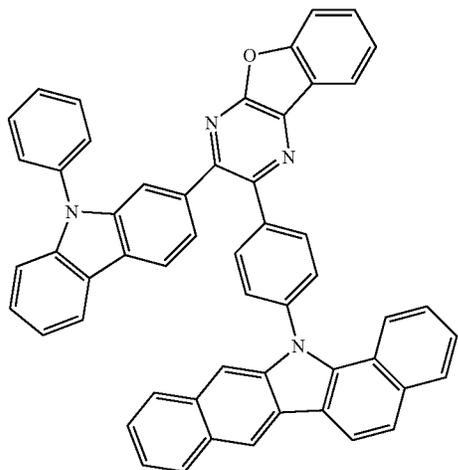
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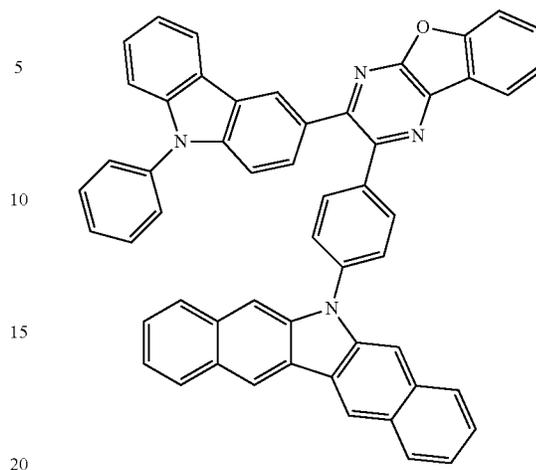


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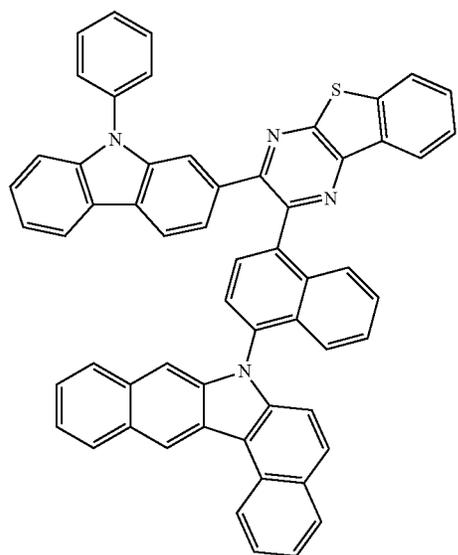


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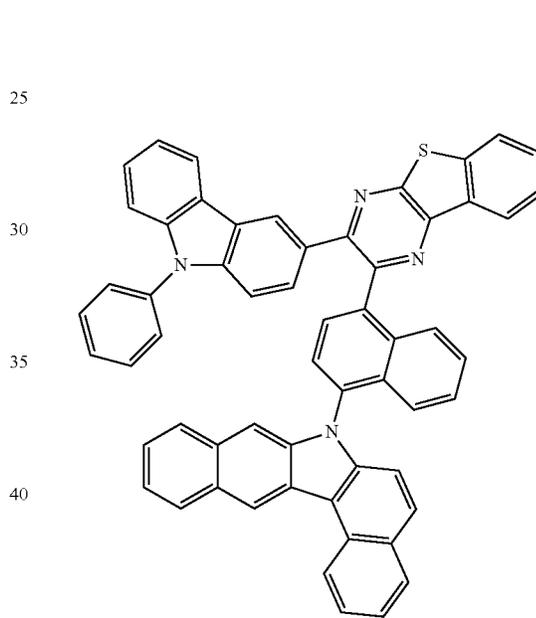
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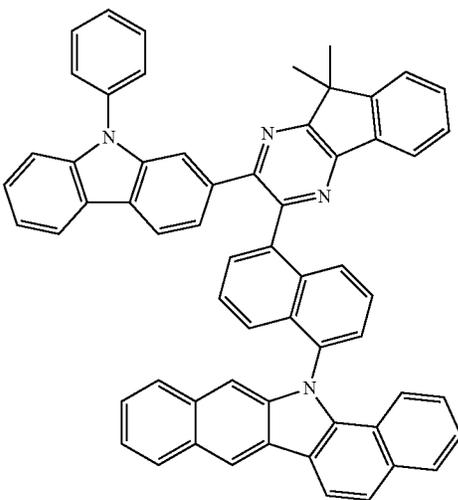
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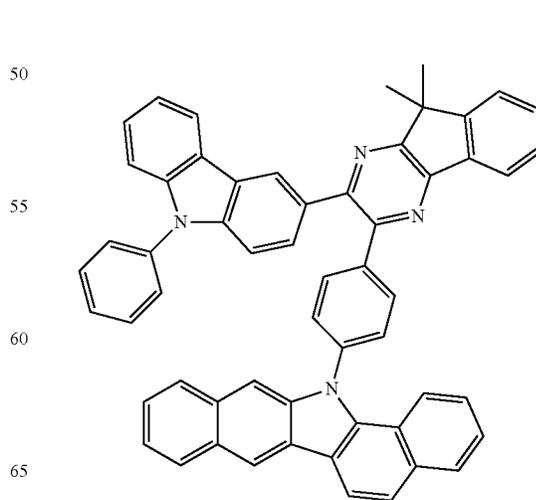
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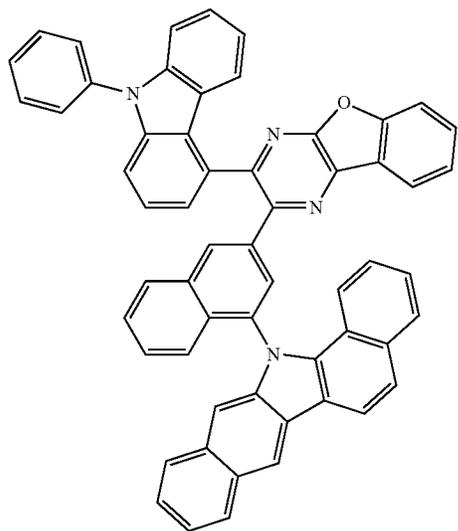
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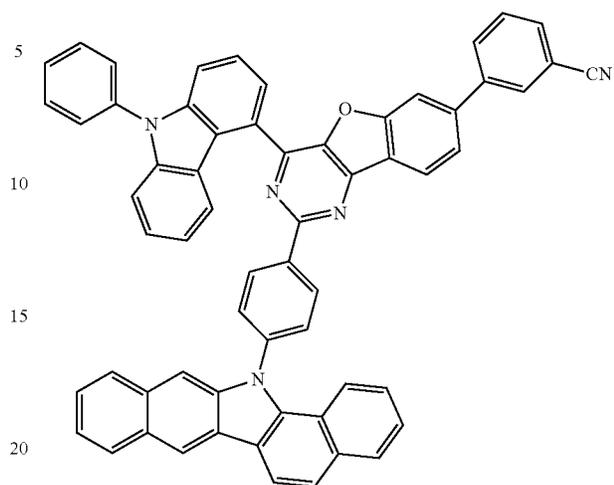
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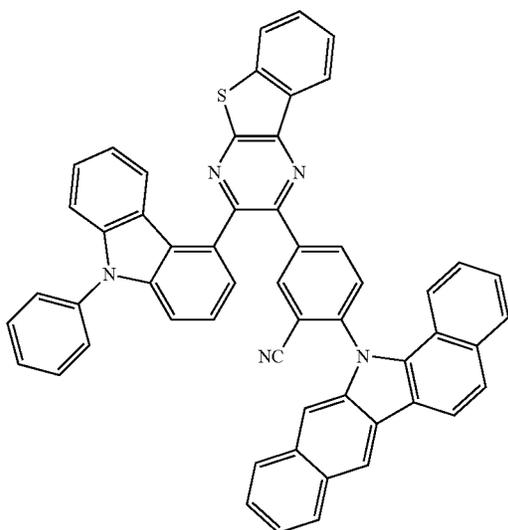
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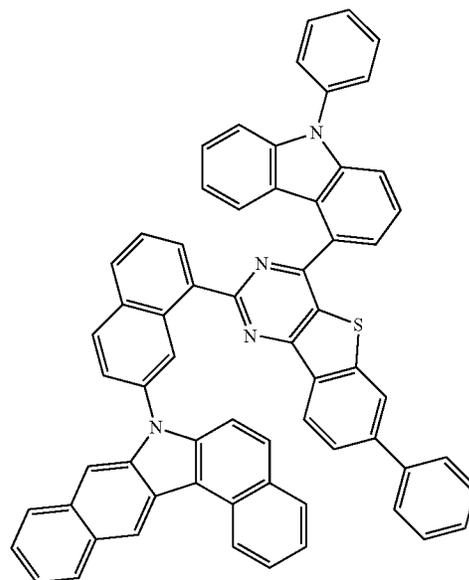
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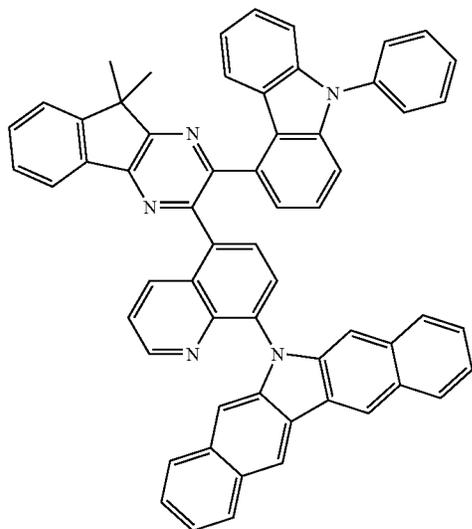
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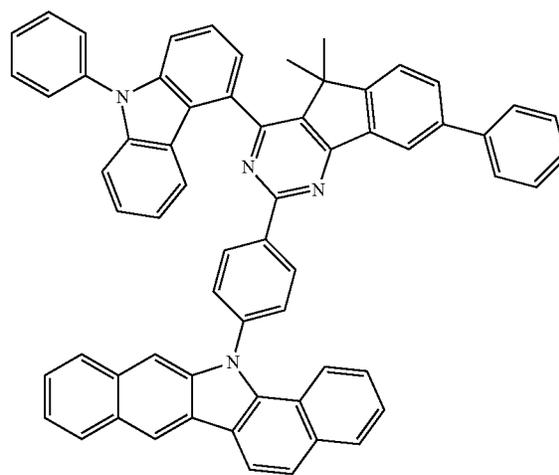
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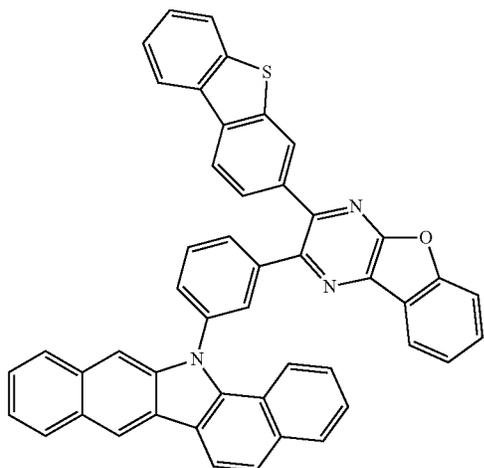
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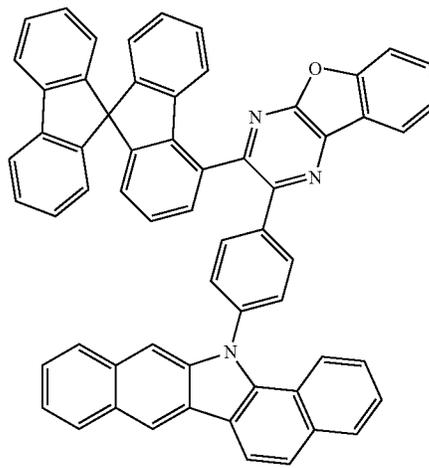
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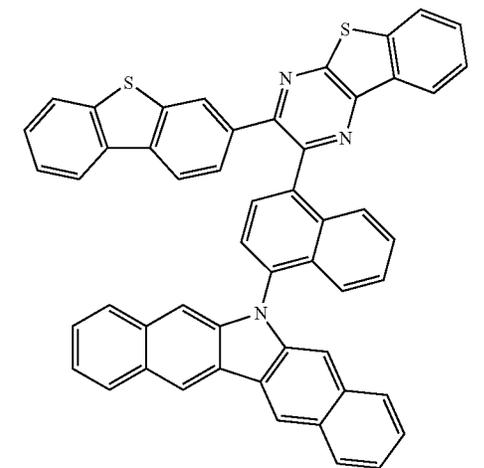
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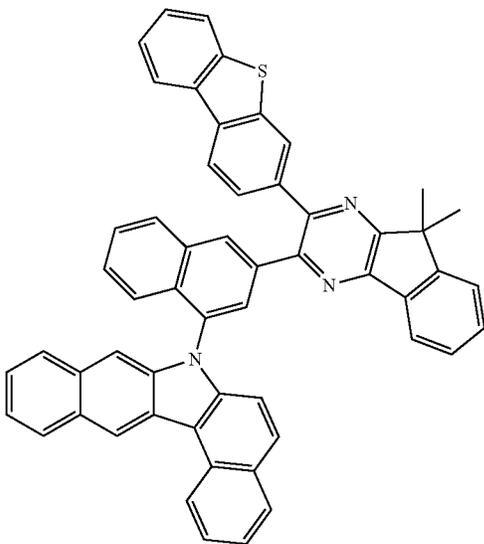
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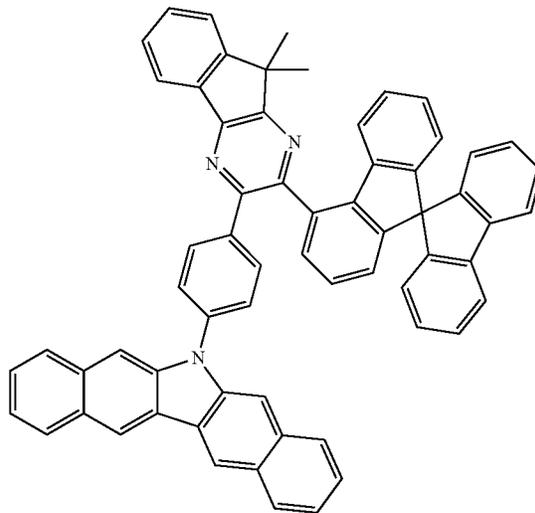
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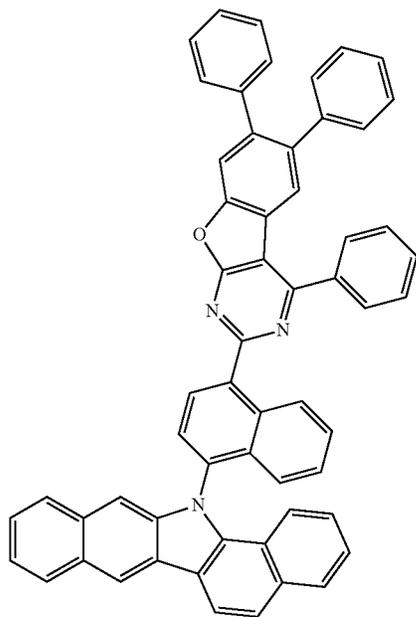


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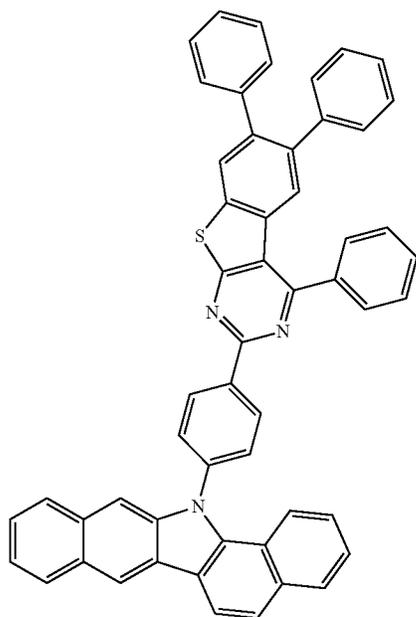
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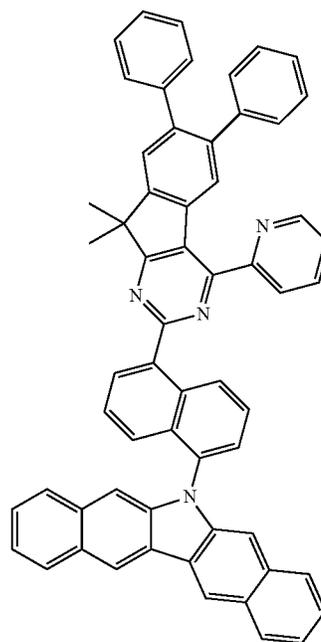
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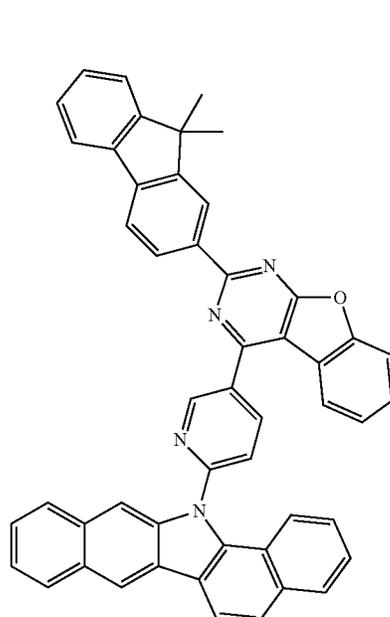


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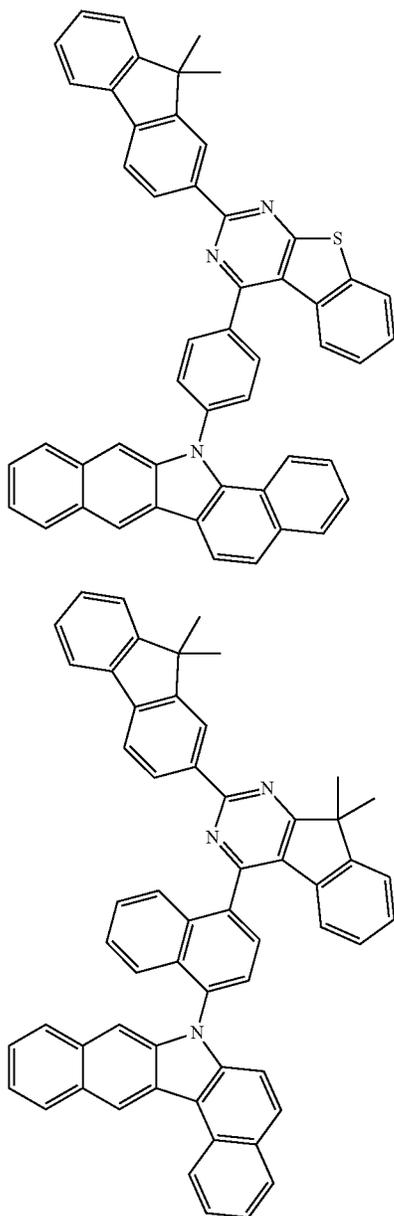
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Another embodiment of the present specification provides an organic light emitting device including the compound described above.

One embodiment of the present specification provides an organic light emitting device including a first electrode; a second electrode provided opposite to the first electrode; and one or more organic material layers provided between the first electrode and the second electrode, wherein one or more layers of the one or more organic material layers include the compound.

In the present specification, a description of a certain member being placed "on" another member includes not only a case of the one member adjoining the another member but a case of still another member being present between the two members.

In the present specification, a description of a certain part "including" certain constituents means capable of further

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including other constituents, and does not exclude other constituents unless particularly stated on the contrary.

The organic material layer of the organic light emitting device of the present specification may be formed in a single layer structure, but may be formed in a multilayer structure in which two or more organic material layers are laminated. For example, the organic light emitting device of the present disclosure may have a structure including a hole injection layer, a hole transfer layer, a light emitting layer, an electron transfer layer, an electron injection layer and the like as the organic material layer. However, the structure of the organic light emitting device is not limited thereto, and may include less numbers of organic material layers.

In one embodiment of the present specification, the one or more organic material layers include a hole injection layer or a hole transfer layer, and the hole injection layer or the hole transfer layer includes the compound.

In one embodiment of the present specification, the one or more organic material layers include a light emitting layer, and the light emitting layer includes the compound.

In one embodiment of the present specification, the one or more organic material layers include an electron transfer layer or an electron injection layer, and the electron transfer layer or the electron injection layer includes the compound.

In one embodiment of the present specification, the organic light emitting device further includes one, two or more layers selected from the group consisting of a hole injection layer, a hole transfer layer, an electron transfer layer, an electron injection layer, an electron blocking layer and a hole blocking layer.

In one embodiment of the present application, the organic light emitting device includes a first electrode; a second electrode provided opposite to the first electrode; a light emitting layer provided between the first electrode and the second electrode; and two or more organic material layers provided between the light emitting layer and the first electrode, or between the light emitting layer and the second electrode, wherein at least one of the two or more organic material layers includes the compound. In one embodiment of the present application, as the two or more organic material layers, two or more may be selected from the group consisting of an electron transfer layer, an electron injection layer, a layer carrying out electron transfer and electron injection at the same time, and a hole blocking layer.

In one embodiment of the present application, the organic material layer includes two or more electron transfer layers, and at least one of the two or more electron transfer layers includes the compound. Specifically, in one embodiment of the present specification, the compound may be included in one of the two or more electron transfer layers, or included in each of the two or more electron transfer layers.

In addition, in one embodiment of the present application, when the compound is included in each of the two or more electron transfer layers, materials other than the compound may be the same as or different from each other.

In one embodiment of the present specification, the organic material layer further includes a hole injection layer or a hole transfer layer including a compound that includes an arylamino group, a carbazole group or a benzocarbazole group in addition to the organic material layer including the compound.

In another embodiment, the organic light emitting device may be an organic light emitting device having a structure in which a first electrode, one or more organic material layers and a second electrode are consecutively laminated on a substrate (normal type).

In another embodiment, the organic light emitting device may be an organic light emitting device having a structure in a reverse direction in which a second electrode, one or more organic material layers and a first electrode are consecutively laminated on a substrate (inverted type).

For example, a structure of the organic light emitting device according to one embodiment of the present specification is illustrated in FIGS. 1 and 2.

FIG. 1 illustrates a structure of the organic light emitting device in which a substrate (1), a first electrode (2), a light emitting layer (3) and a second electrode (4) are consecutively laminated. In such a structure, the compound may be included in the light emitting layer (3).

FIG. 2 illustrates a structure of the organic light emitting device in which a substrate (1), a first electrode (2), a hole injection layer (5), a hole transfer layer (6), a light emitting layer (3), an electron transfer layer (7) and a second electrode (4) are consecutively laminated. In such a structure, the compound may be included in one or more layers of the hole injection layer (5), the hole transfer layer (6), the light emitting layer (3) and the electron transfer layer (7).

In such a structure, the compound may be included in one or more layers of the hole injection layer, the hole transfer layer, the light emitting layer and the electron transfer layer.

The organic light emitting device of the present specification may be manufactured using materials and methods known in the art, except that one or more layers of the organic material layers include the compound of the present specification, that is, the above-mentioned compound.

When the organic light emitting device includes a plurality of organic material layers, the organic material layers may be formed with materials the same as or different from each other.

The organic light emitting device of the present specification may be manufactured using materials and methods known in the art, except that one or more layers of the organic material layers include the above-mentioned compound, that is, the compound represented by Chemical Formula 1.

For example, the organic light emitting device of the present specification may be manufactured by consecutively laminating a first electrode, an organic material layer and a second electrode on a substrate. Herein, the organic light emitting device may be manufactured by forming a first electrode on a substrate by depositing a metal, a metal oxide having conductivity, or an alloy thereof using a physical vapor deposition (PVD) method such as sputtering or e-beam evaporation, and forming an organic material layer including a hole injection layer, a hole transfer layer, a light emitting layer and an electron transfer layer thereon, and then depositing a material capable of being used as a second electrode thereon. In addition to such a method, the organic light emitting device may also be manufactured by consecutively depositing a second electrode material, an organic material layer and a first electrode material on a substrate.

In addition, the compound of Chemical Formula 1 may be formed into an organic material layer using a solution coating method as well as a vacuum deposition method when manufacturing the organic light emitting device. Herein, the solution coating method means spin coating, dip coating, doctor blading, inkjet printing, screen printing, a spray method, roll coating and the like, but is not limited thereto.

In addition to such as method, the organic light emitting device may also be manufactured by consecutively laminating a second electrode material, an organic material layer and a first electrode material on a substrate (International

Patent Application Laid-Open Publication No. 2003/012890). However, the manufacturing method is not limited thereto.

In one embodiment of the present specification, the first electrode is an anode, and the second electrode is a cathode.

In another embodiment, the first electrode is a cathode, and the second electrode is an anode.

As the first electrode material, materials having large work function are normally preferred so that hole injection to an organic material layer is smooth. Specific examples of the first electrode material capable of being used in the present disclosure include metals such as vanadium, chromium, copper, zinc and gold, or alloys thereof; metal oxides such as zinc oxide, indium oxide, indium tin oxide (ITO) and indium zinc oxide (IZO); combinations of metals and oxides such as ZnO:Al or SnO<sub>2</sub>:Sb; conductive polymers such as poly(3-methylthiophene), poly[3,4-(ethylene-1,2-dioxy)thiophene] (PEDOT), polypyrrole and polyaniline, but are not limited thereto.

As the second electrode material, materials having small work function are normally preferred so that electron injection to an organic material layer is smooth. Specific examples of the second electrode material include metals such as magnesium, calcium, sodium, potassium, titanium, indium, yttrium, lithium, gadolinium, aluminum, silver, tin and lead, or alloys thereof; multilayer structure materials such as LiF/Al or LiO<sub>2</sub>/Al, and the like, but are not limited thereto.

The hole injection material is a layer that injects holes from an electrode, and the hole injection material is preferably a compound that has an ability to transfer holes, therefore, has a hole injection effect in a first electrode, has an excellent hole injection effect for a light emitting layer or a light emitting material, prevents excitons generated in the light emitting layer from moving to an electron injection layer or an electron injection material, and in addition thereto, has an excellent thin film forming ability. The highest occupied molecular orbital (HOMO) of the hole injection material is preferably in between the work function of a first electrode material and the HOMO of surrounding organic material layers. Specific examples of the hole injection material include metal porphyrins, oligothiophene, arylamine-based organic materials, hexanitride hexaazatriphenylene-based organic materials, quinacridone-based organic materials, perylene-based organic materials, anthraquinone, and polyaniline- and polythiophene-based conductive polymers, and the like, but are not limited thereto.

The hole transfer layer is a layer that receives holes from a hole injection layer and transfers the holes to a light emitting layer, and as the hole transfer material, materials capable of receiving holes from a first electrode or a hole injection layer, moving the holes to a light emitting layer, and having high mobility for the holes are suitable. Specific examples thereof include arylamine-based organic materials, conductive polymers, block copolymers having conjugated parts and non-conjugated parts together, and the like, but are not limited thereto.

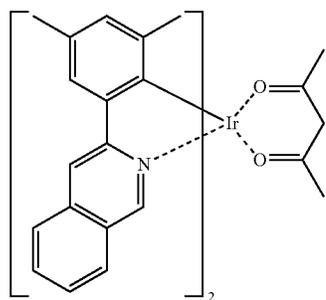
The light emitting material is a material capable of emitting light in a visible light region by receiving holes and electrons from a hole transfer layer and an electron transfer layer, respectively, and binding the holes and the electrons, and is preferably a material having favorable quantum efficiency for fluorescence or phosphorescence. Specific examples thereof include 8-hydroxyquinoline aluminum complexes (Alq<sub>3</sub>); carbazole series compounds; dimerized styryl compounds; BAq; 10-hydroxybenzo quinoline-metal compounds; benzoxazole, benzothiazole and benzimidazole

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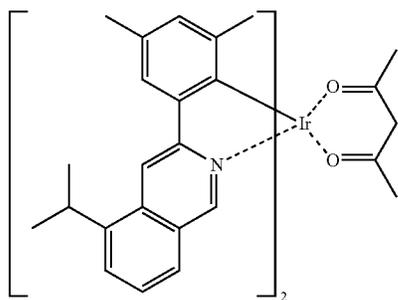
series compounds; poly(p-phenylenevinylene) (PPV) series polymers; spiro compounds; polyfluorene, rubrene, and the like, but are not limited thereto.

The light emitting layer may include a host material and a dopant material. The host material includes fused aromatic ring derivatives, heteroring-containing compounds or the like. Specifically, the fused aromatic ring derivative includes anthracene derivatives, pyrene derivatives, naphthalene derivatives, pentacene derivatives, phenanthrene compounds, fluoranthene compounds and the like, and the heteroring-containing compound includes dibenzofuran derivatives, ladder-type furan compounds, pyrimidine derivatives and the like, but the material is not limited thereto.

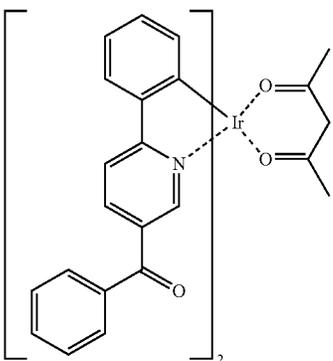
The dopant material may include compounds as below, but is not limited thereto.



Dp-1



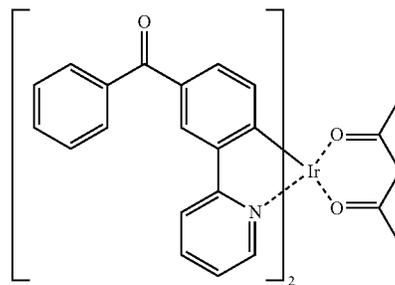
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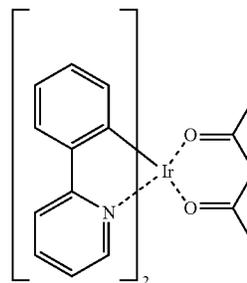
Dp-3

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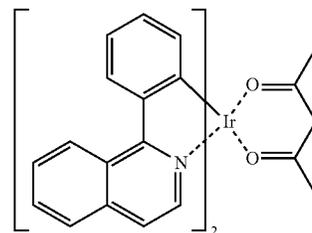
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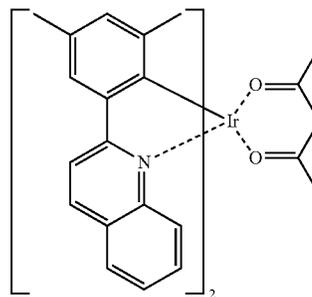
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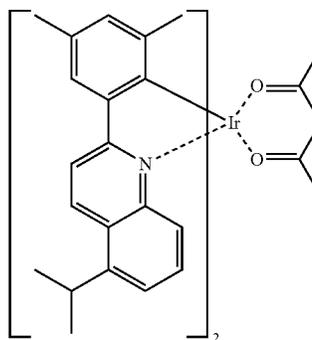
Dp-5



Dp-6



Dp-7



Dp-8

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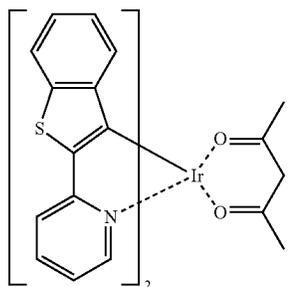
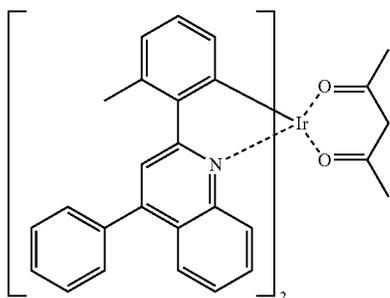
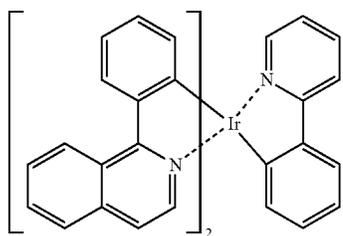
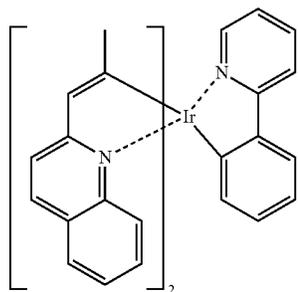
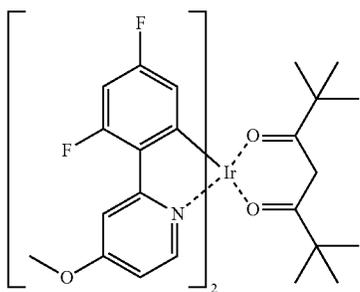
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Dp-12

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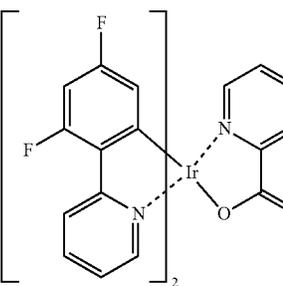
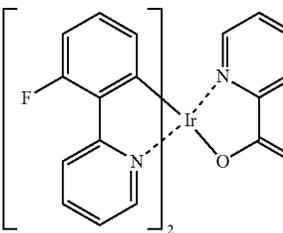
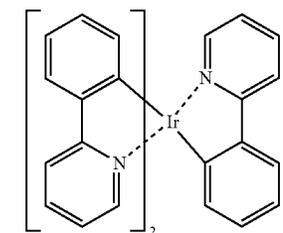
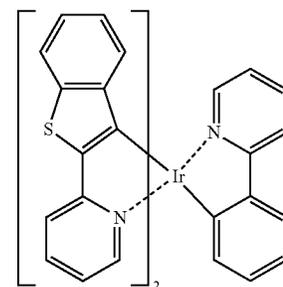
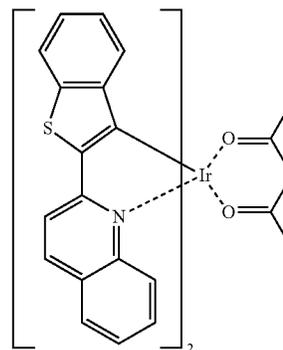
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Dp-13

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Dp-14

Dp-15

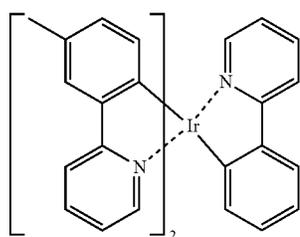
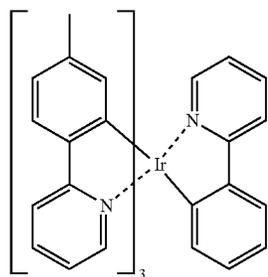
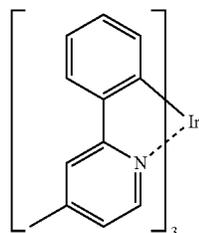
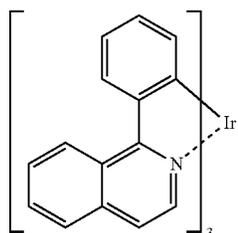
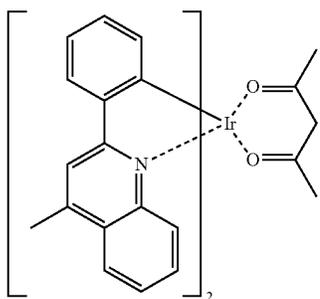
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Dp-15

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Dp-18 25

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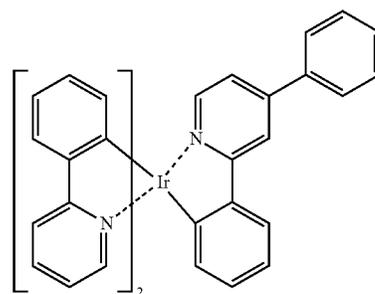
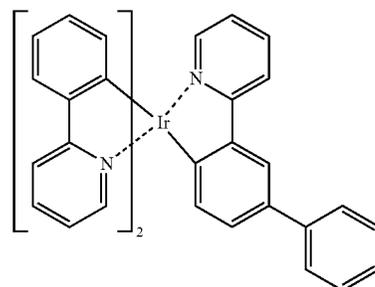
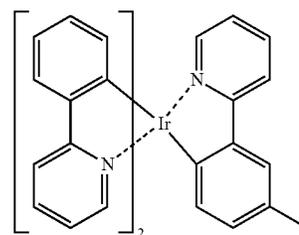
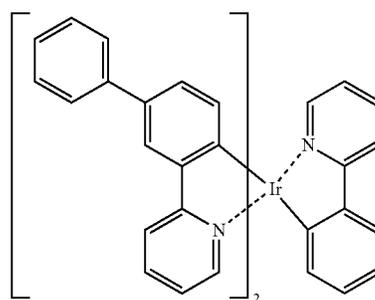
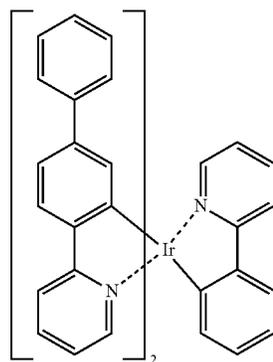
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Dp-21

Dp-22

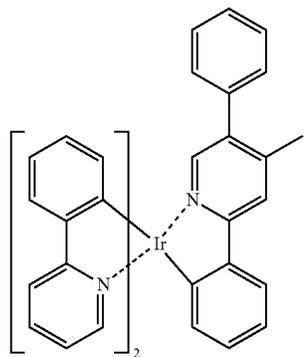
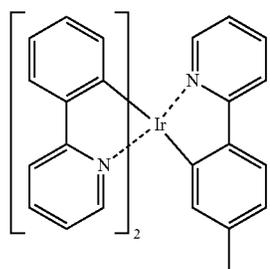
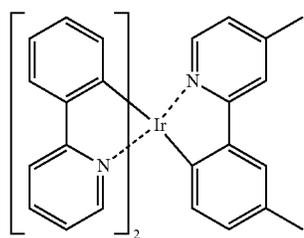
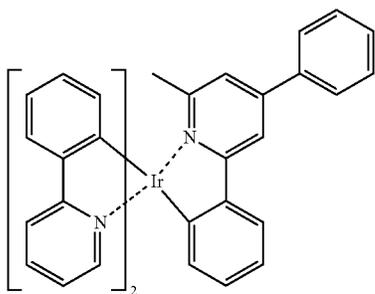
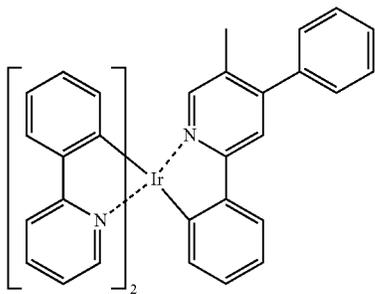
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Dp-25

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Dp-26

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Dp-27

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Dp-28

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Dp-29

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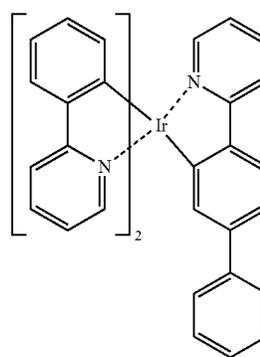
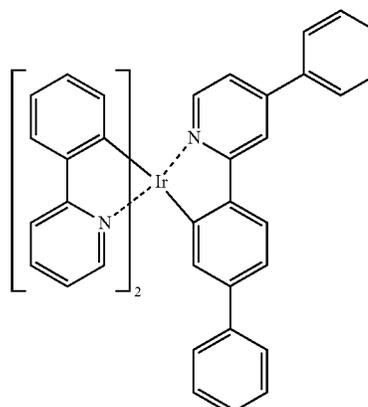
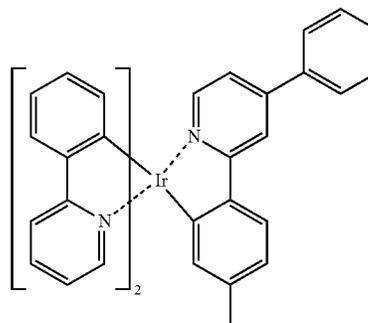
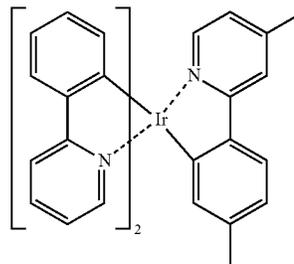
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Dp-30

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Dp-31

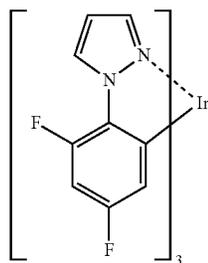
Dp-32

Dp-33

Dp-34

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The electron transfer layer is a layer that receives electrons from an electron injection layer and transfers the electrons to a light emitting layer, and as the electron transfer material, materials capable of favorably receiving electrons from a second electrode, moving the electrons to a light emitting layer, and having high mobility for the electrons are suitable. Specific examples thereof include Al complexes of 8-hydroxyquinoline; complexes including Alq<sub>3</sub>; organic radical compounds; hydroxyflavon-metal complexes, and the like, but are not limited thereto. The electron transfer layer may be used together with any desired cathode material as used in the art. Particularly, examples of the suitable cathode material include common materials that have small work function, and in which an aluminum layer or a silver layer follows. Specifically, the cathode material includes cesium, barium, calcium, ytterbium and samarium, and in each case, an aluminum layer or a silver layer follows.

The electron injection layer is a layer that injects electrons from an electrode, and the electron injection material is preferably a compound that has an ability to transfer electrons, has an electron injection effect from a second electrode, has an excellent electron injection effect for a light emitting layer or a light emitting material, prevents excitons generated in the light emitting layer from moving to a hole injection layer, and in addition, has an excellent thin film forming ability. Specific examples thereof include fluorenone, anthraquinodimethane, diphenquinone, thiopyran dioxide, oxazole, oxadiazole, triazole, imidazole, perylene tetracarboxylic acid, fluorenylidene methane, anthrone or the like, and derivatives thereof, metal complex compounds, nitrogen-containing 5-membered ring derivatives, and the like, but are not limited thereto.

The metal complex compound includes 8-hydroxyquinolinato lithium, bis(8-hydroxyquinolinato)zinc, bis(8-hydroxyquinolinato)copper, bis(8-hydroxyquinolinato)manganese, tris(8-hydroxyquinolinato)aluminum, tris(2-methyl-8-hydroxyquinolinato)aluminum, tris(8-hydroxyquinolinato)gallium, bis(10-hydroxybenzo[h]quinolinato)beryllium, bis(10-hydroxybenzo[h]quinolinato)zinc, bis(2-methyl-8-quinolinato)chlorogallium, bis(2-methyl-8-quinolinato)(o-cresolato)gallium, bis(2-methyl-8-quinolinato)(1-naphtholato)aluminum, bis(2-methyl-8-quinolinato)(2-naphtholato)gallium and the like, but is not limited thereto.

The hole blocking layer is a layer blocking holes from reaching a second electrode and may be generally formed under the same condition as the hole injection layer. Specifically, oxadiazole derivatives, triazole derivatives, phenanthroline derivatives, BCP, aluminum complexes and the like are included, however, the hole blocking layer is not limited thereto.

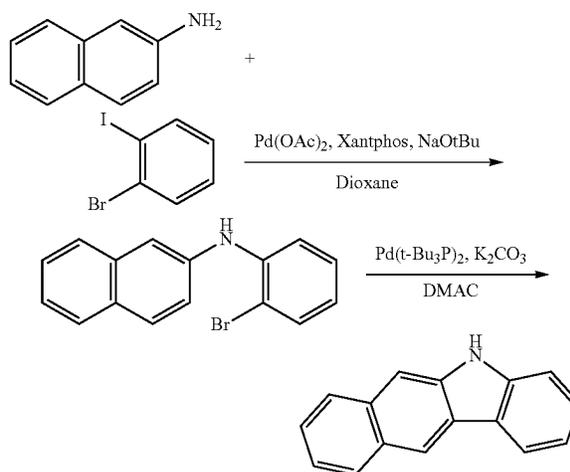
The organic light emitting device according to the present specification may be a top-emission type, a bottom-emission type or a dual-emission type depending on the materials used.

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Methods for preparing the compound of Chemical Formula 1 and manufacturing of an organic light emitting device using the same will be specifically described in the following examples. However, the following examples are for illustrative purposes only, and the scope of the present disclosure is not limited thereby.

The compound of the present disclosure was prepared using a Buchwald-Hartwig coupling reaction, a Heck coupling reaction, a Suzuki coupling reaction and the like as a typical reaction, and evaluations on the device were progressed after purifying and the sublimation purifying all the compounds.

## PREPARATION EXAMPLE 1



## 1) Preparation of Chemical Formula a-1

Naphthalen-2-amine (300.0 g, 1.0 eq.), 1-bromo-2-iodobenzene (592.7 g, 1.0 eq.), NaOtBu (302.0 g, 1.5 eq.), Pd(OAc)<sub>2</sub> (4.70 g, 0.01 eq.) and Xantphos (12.12 g, 0.01 eq.) were dissolved in 1,4-dioxane (5 L), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in ethyl acetate, washed with water, and then approximately 70% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding hexane thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound a-1 (443.5 g, yield 71%). [M+H]=299

## 2) Preparation of Chemical Formula a (5H-benzo[b]carbazole)

Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (8.56 g, 0.01 eq.) and K<sub>2</sub>CO<sub>3</sub> (463.2 g, 2.00 eq.) were added to Chemical Formula a-1 (443.5 g, 1.0 eq.) in dimethylacetamide (4 L), and the result was stirred under reflux. After 3 hours, the reaction material was poured into water to drop crystals, and the result was filtered. The filtered solids were completely dissolved in 1,2-dichlorobenzene, then washed with water, and the product-dissolved solution was vacuum concentrated to drop crystals, and the result was cooled and then filtered. This was purified using column chromatography to obtain Chemical Formula a (5H-benzo[b]carbazole) (174.8 g, yield 48%). [M+H]=218

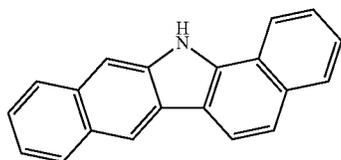
FIG. 3 is a graph showing an 1H-NMR value of Chemical Formula a, and FIG. 4 is a graph showing an MS value of Chemical Formula a.

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## PREPARATION EXAMPLE 2

Preparation of Chemical Formula b  
(13H-dibenzo[a,h]carbazole)

13H-dibenzo[a,h]carbazole was synthesized using the same method as the preparation method of Chemical Formula a except that 2-bromo-1-iodonaphthalene was used instead of 1-bromo-2-iodobenzene.

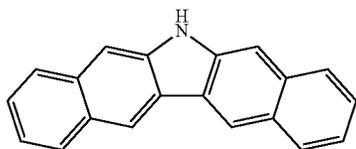


13H-dibenzo[a,h]carbazole

## PREPARATION EXAMPLE 3

Preparation of Chemical Formula c  
(6H-dibenzo[b,h]carbazole)

6H-dibenzo[b,h]carbazole was synthesized using the same method as the preparation method of Chemical Formula a except that 2,3-dibromonaphthalene was used instead of 1-bromo-2-iodobenzene.



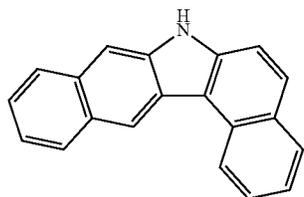
6H-dibenzo[b,h]carbazole

## PREPARATION EXAMPLE 4

Preparation of Chemical Formula d  
(7H-dibenzo[b,g]carbazole)

7H-dibenzo[b,g]carbazole was synthesized using the same method as the preparation method of Chemical Formula a except that 1-bromo-2-iodonaphthalene was used instead of 1-bromo-2-iodobenzene.

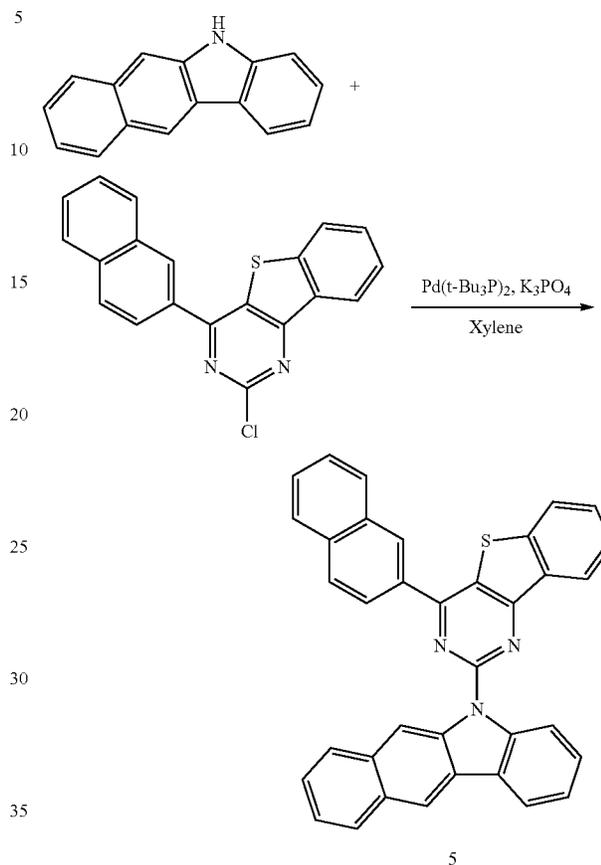
FIG. 5 is a graph showing an <sup>1</sup>H-NMR value of Chemical Formula d.



7H-dibenzo[b,g]carbazole

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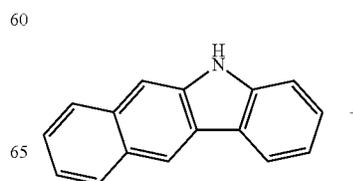
## SYNTHESIS EXAMPLE 1



Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(naphthalen-2-yl)benzo[4,5]thieno[3,2-d]pyrimidine (17.55 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 5 (21.12 g, yield 87%).  $[M+H]^+=528$

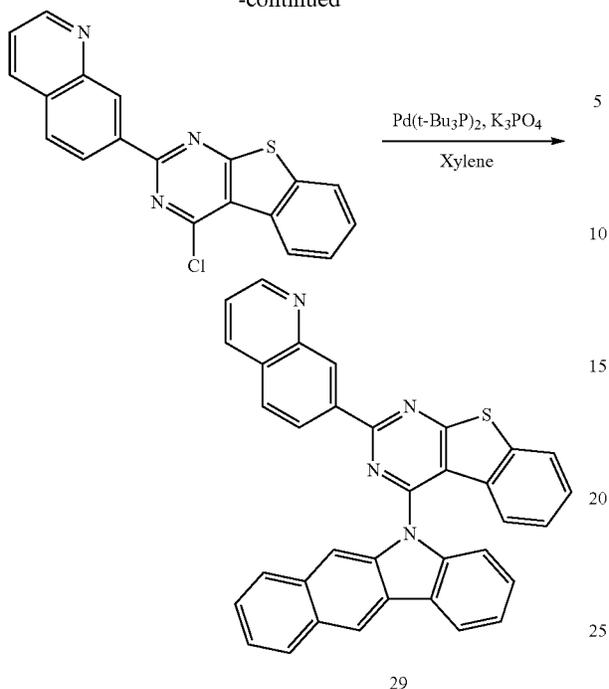
FIG. 6 is a graph showing an <sup>1</sup>H-NMR value of Chemical Formula 5.

## SYNTHESIS EXAMPLE 2



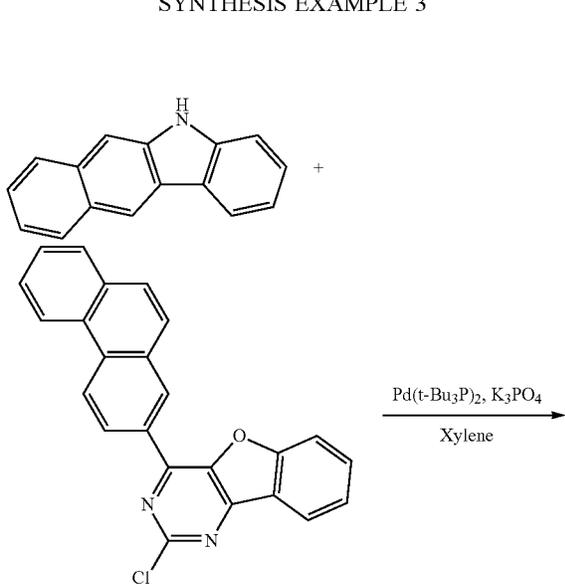
361

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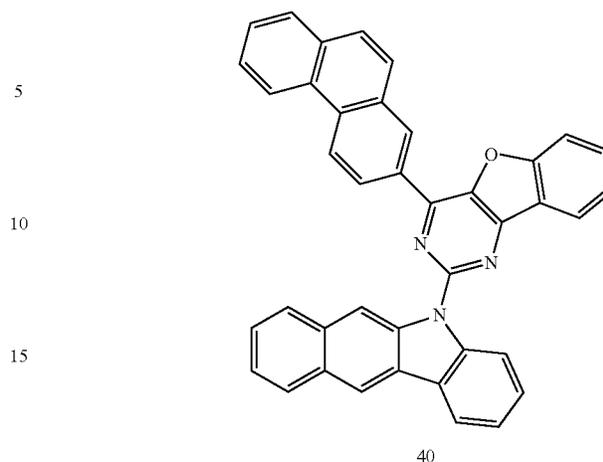
Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(quinolin-7-yl)benzo[4,5]thieno[2,3-d]pyrimidine (17.60 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 29 (17.27 g, yield 71%). [M+H]=529

SYNTHESIS EXAMPLE 3



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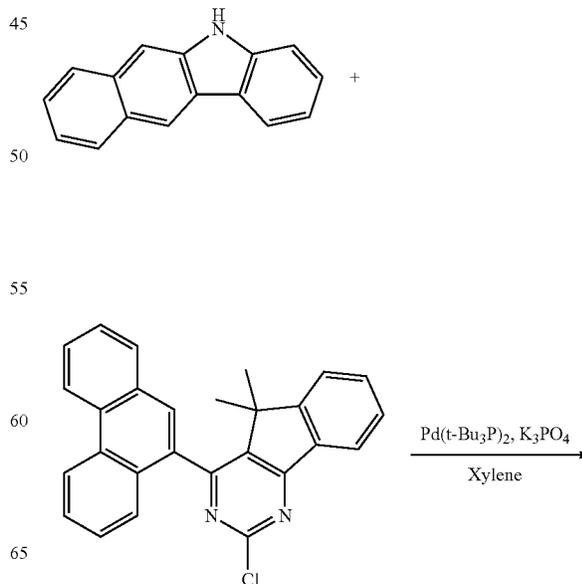
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Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(phenanthren-2-yl)benzofuro[3,2-d]pyrimidine (19.28 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 40 (18.87 g, yield 73%). [M+H]=562

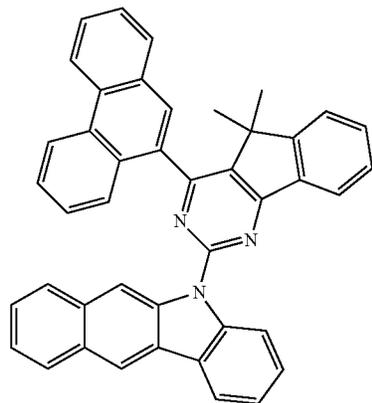
FIG. 7 is a graph showing an 1H-NMR value of Chemical Formula 40.

SYNTHESIS EXAMPLE 4



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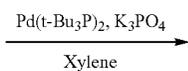
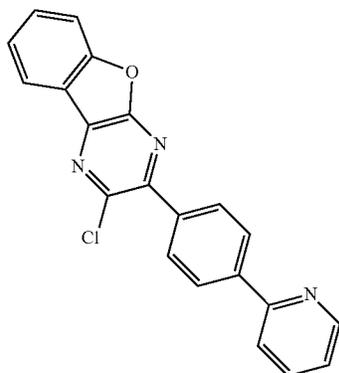
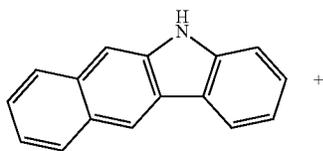
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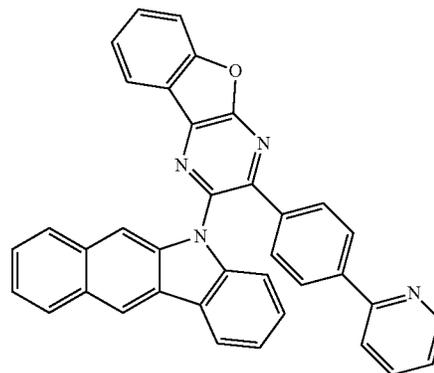
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(4-(pyridin-2-yl)phenyl)benzofuro[2,3-b]pyrazine (18.11 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 42 (18.93 g, yield 70%).  $[M+H]=588$

## SYNTHESIS EXAMPLE 5



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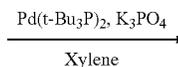
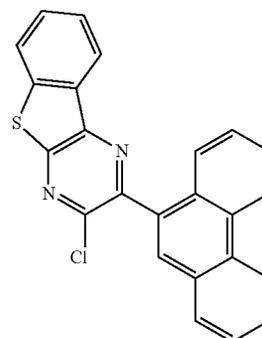
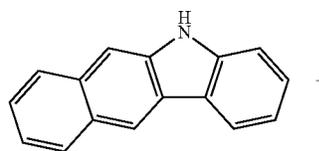
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43

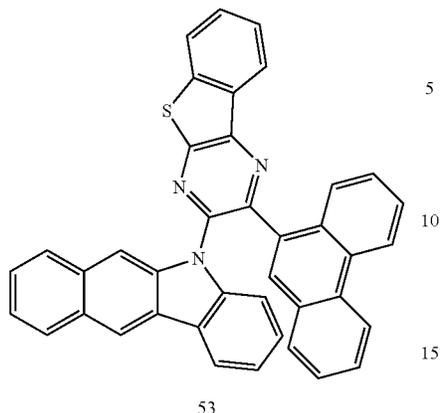
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(4-(pyridin-2-yl)phenyl)benzofuro[2,3-b]pyrazine (18.11 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 43 (15.86 g, yield 64%).  $[M+H]=539$

## SYNTHESIS EXAMPLE 6



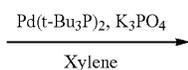
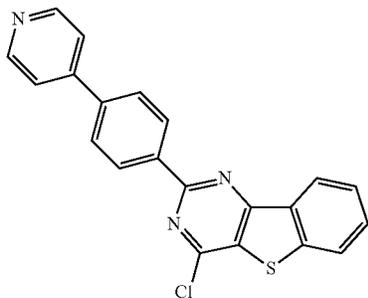
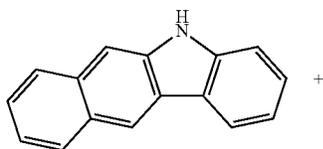
365

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Chemical Formula a (10.0 g, 1.0 eq.), 3-chloro-2-(phenanthren-9-yl)benzothieno[2,3-b]pyrazine (20.09 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 53 (16.48 g, yield 62%).  $[M+H]=578$

## SYNTHESIS EXAMPLE 7



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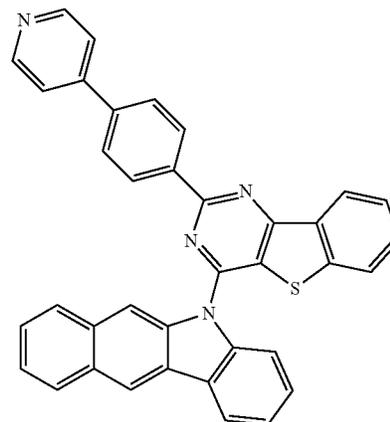
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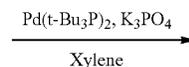
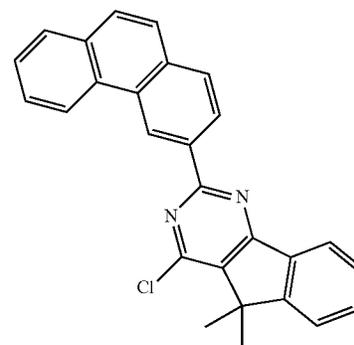
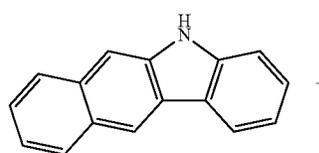
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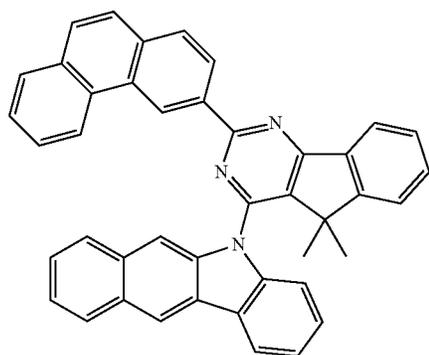
Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(4-(pyridin-4-yl)phenyl)benzo[4,5]thieno[3,2-d]pyrimidine (18.92 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 56 (16.59 g, yield 65%).  $[M+H]=555$

## SYNTHESIS EXAMPLE 8



367

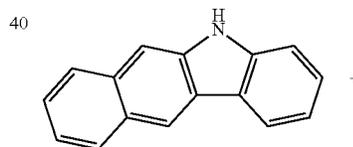
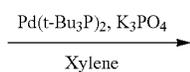
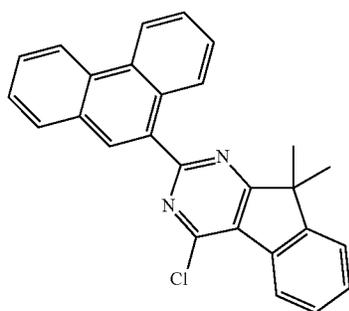
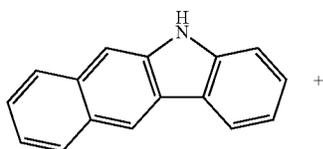
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60

Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-5,5-dimethyl-2-(phenanthren-3-yl)-5H-indeno[1,2-d]pyrimidine (20.60 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 60 (16.50 g, yield 61%).  $[M+H]=588$

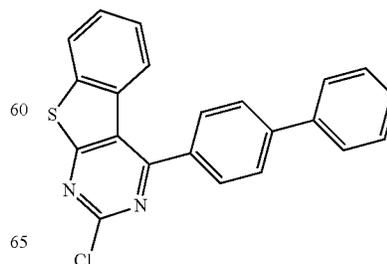
## SYNTHESIS EXAMPLE 9



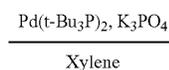
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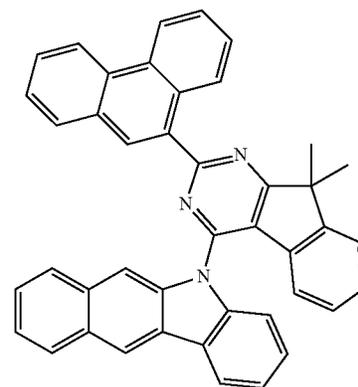


65



368

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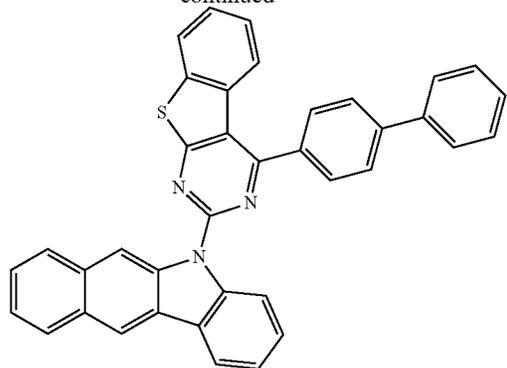
66

Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-9,9-dimethyl-2-(phenanthren-9-yl)-9H-indeno[2,1-d]pyrimidine (20.60 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 66 (17.31 g, yield 64%).  $[M+H]=588$

## SYNTHESIS EXAMPLE 10

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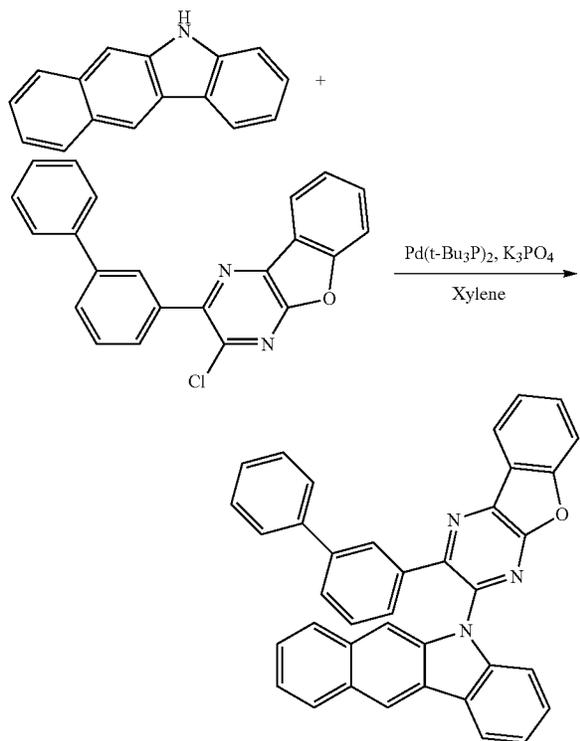
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68

Chemical Formula a (10.0 g, 1.0 eq.), 4-([1,1'-biphenyl]-4-yl)-2-chlorobenzo[4,5]thieno[2,3-d]pyrimidine (16.59 g, 2.0 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 68 (17.07 g, yield 67%).  $[M+H]=554$

## SYNTHESIS EXAMPLE 11

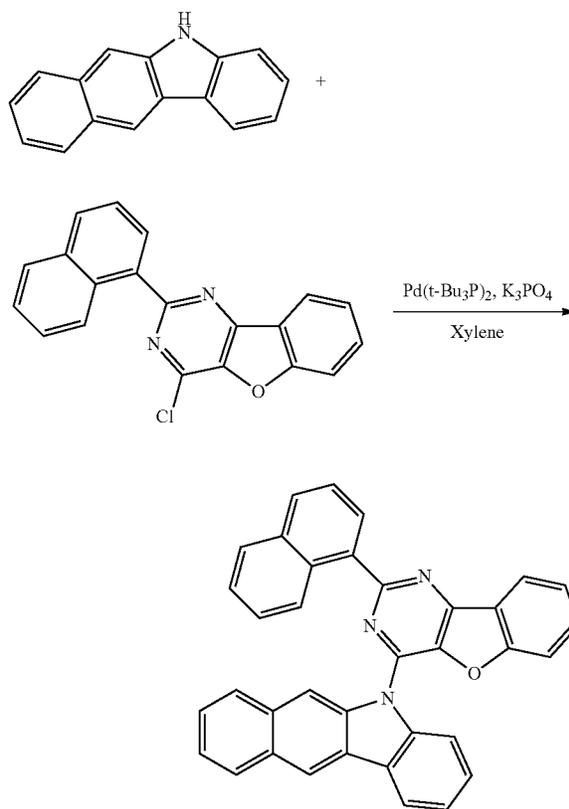


88

370

Chemical Formula a (10.0 g, 1.0 eq.), 2-([1,1'-biphenyl]-3-yl)-3-chlorobenzofuro[2,3-b]pyrazine (18.06 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 88 (15.58 g, yield 63%).  $[M+H]=538$

## SYNTHESIS EXAMPLE 12

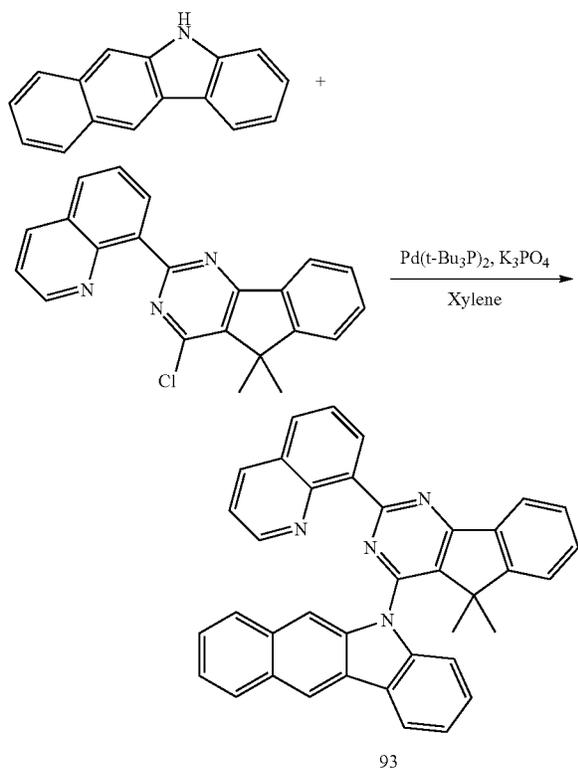


91

Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(naphthalen-1-yl)benzo[4,5]furo[3,2-d]pyrimidine (16.74 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 91 (15.77 g, yield 67%).  $[M+H]=512$

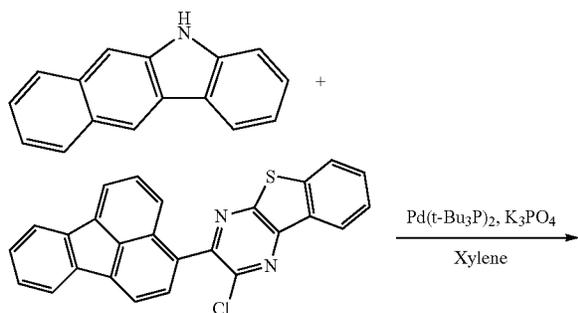
371

## SYNTHESIS EXAMPLE 13



Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-5,5-dimethyl-2-(quinolin-8-yl)-5H-indeno[1,2-d]pyrimidine (18.11 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 93 (16.11 g, yield 65%).  $[M+H]=539$

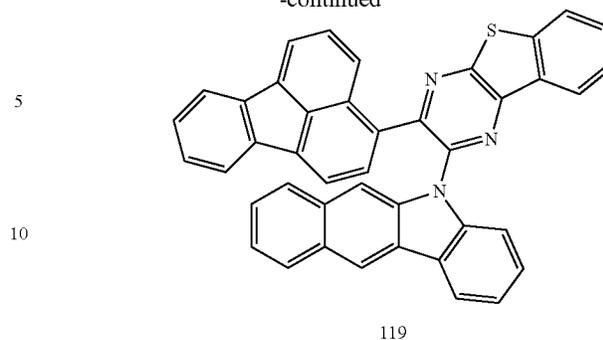
## SYNTHESIS EXAMPLE 14



Chemical Formula a (10.0 g, 1.0 eq.), 3-chloro-2-(fluoren-3-yl)-9,9-dimethyl-9H-indeno[1,2-b]pyrazine (21.81 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under

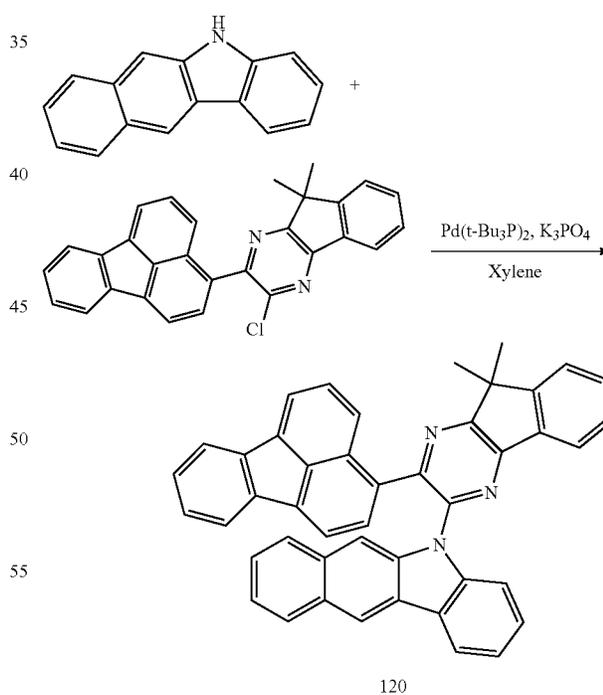
372

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Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(fluoren-3-yl)benzo[4,5]thieno[2,3-b]pyrazine (21.30 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 119 (17.72 g, yield 64%).  $[M+H]=602$

## SYNTHESIS EXAMPLE 15

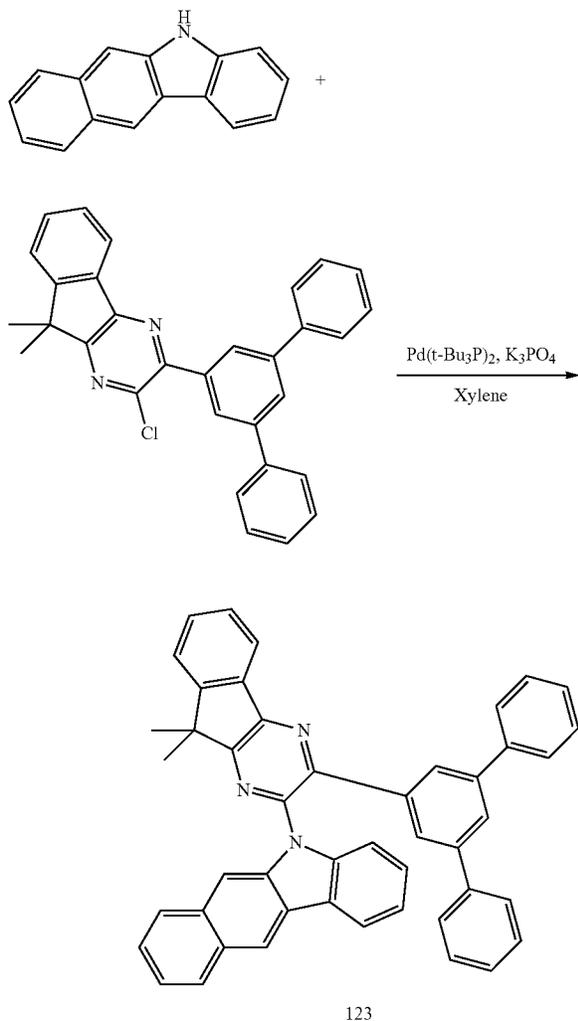


Chemical Formula a (10.0 g, 1.0 eq.), 3-chloro-2-(fluoren-3-yl)-9,9-dimethyl-9H-indeno[1,2-b]pyrazine (21.81 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under

373

vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 120 (17.17 g, yield 61%).  $[\text{M}+\text{H}]=612$

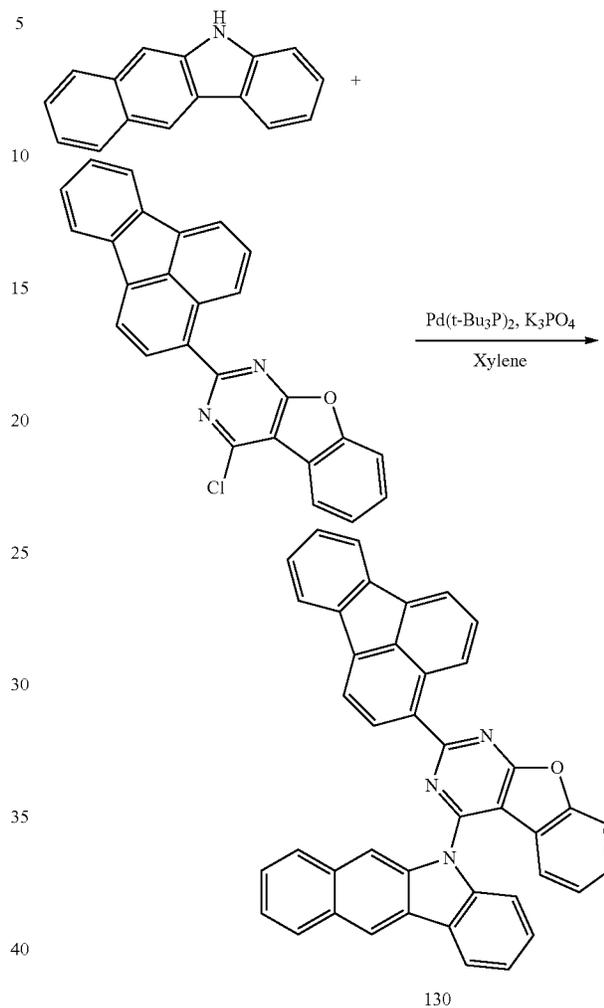
## SYNTHESIS EXAMPLE 16



Chemical Formula a (10.0 g, 1.0 eq.), 3-([1,1':3',1''-terphenyl]-5'-yl)-2-chloro-9,9-dimethyl-9H-indeno[1,2-b]pyridine (23.23 g, 1.1 eq.),  $\text{K}_3\text{PO}_4$  (19.53 g, 2.0 eq.) and  $\text{Pd}(\text{t-Bu}_3\text{P})_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 123 (18.84 g, yield 64%).  $[\text{M}+\text{H}]=640$

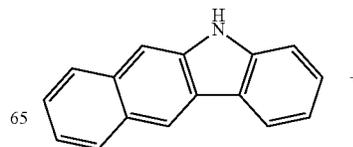
374

## SYNTHESIS EXAMPLE 17



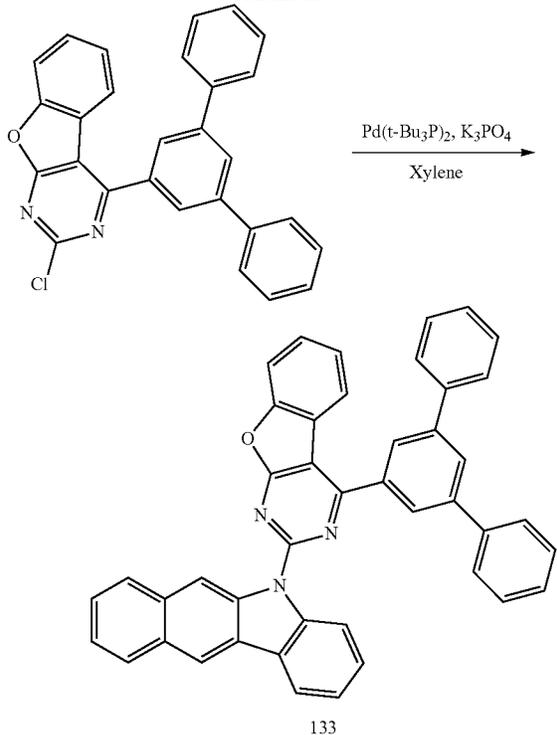
Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(fluorenyl)benzofuro[2,3-d]pyrimidine (20.49 g, 1.1 eq.),  $\text{K}_3\text{PO}_4$  (19.53 g, 2.0 eq.) and  $\text{Pd}(\text{t-Bu}_3\text{P})_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 130 (18.06 g, yield 67%).  $[\text{M}+\text{H}]=586$

## SYNTHESIS EXAMPLE 18



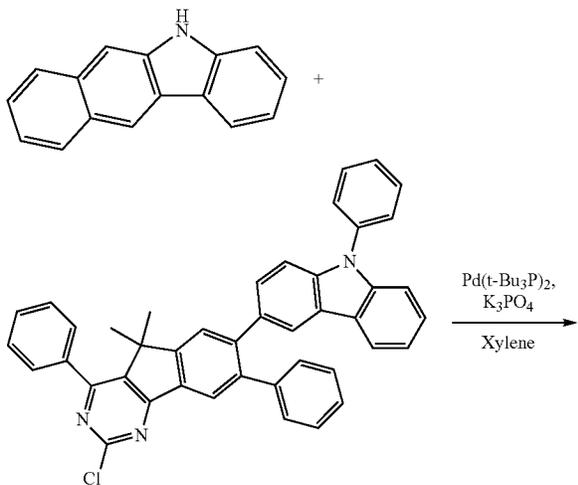
375

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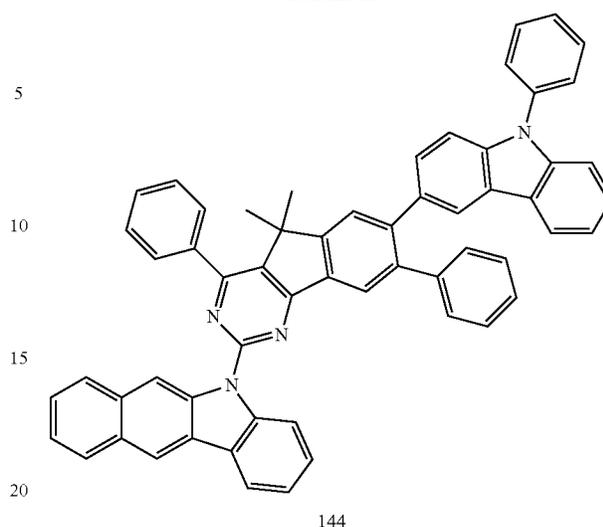
Chemical Formula a (10.0 g, 1.0 eq.), 4-([1,1':3',1''-terphenyl]-5'-yl)-2-chlorobenzofuro[2,3-d]pyrimidine (21.91 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 133 (18.36 g, yield 65%). [M+H]<sup>+</sup>=614

## SYNTHESIS EXAMPLE 19



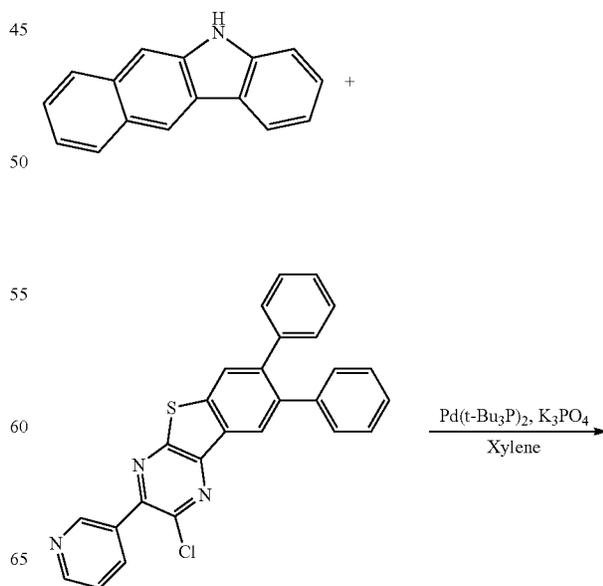
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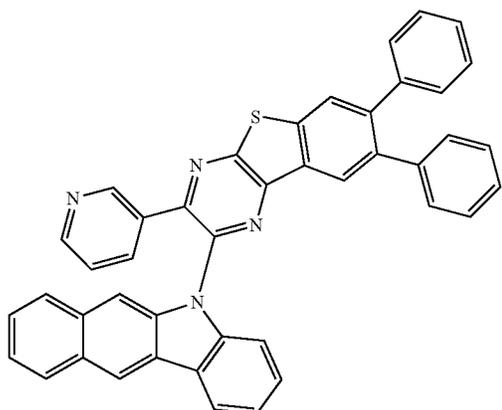
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-5,5-dimethyl-4,8-diphenyl-7-(9-phenyl-9H-carbazol-3-yl)-5H-indeno[1,2-d]pyrimidine (31.60 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 144 (22.97 g, yield 62%). [M+H]<sup>+</sup>=805

## SYNTHESIS EXAMPLE 20



377

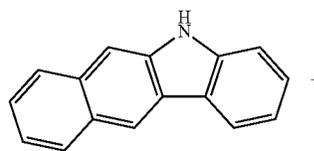
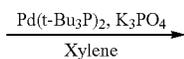
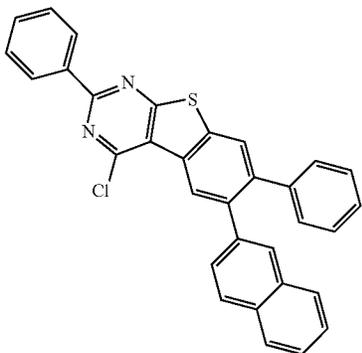
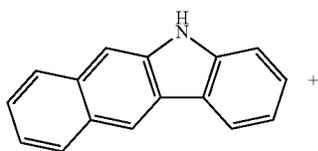
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149

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-6-(naphthalen-2-yl)-2,7-diphenylbenzo[4,5]thieno[2,3-d]pyrimidine (22.78 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 149 (17.41 g, yield 60%).  $[M+H]=631$

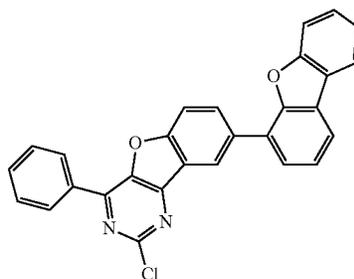
## SYNTHESIS EXAMPLE 21



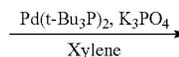
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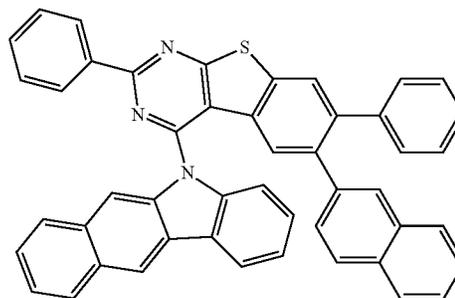


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378

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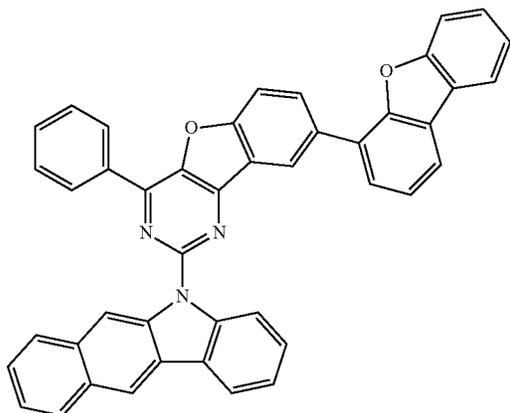
167

Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-6-(naphthalen-2-yl)-2,7-diphenylbenzo[4,5]thieno[2,3-d]pyrimidine (22.73 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 167 (19.39 g, yield 62%).  $[M+H]=680$

## SYNTHESIS EXAMPLE 22

379

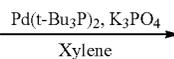
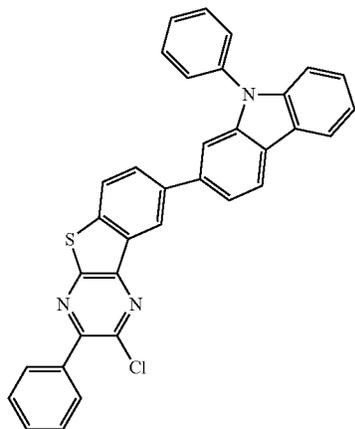
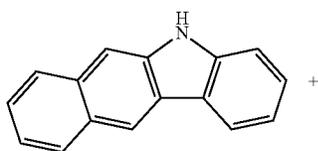
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175

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-8-(dibenzo [b,d]furan-4-yl)-4-phenylbenzofuro[3,2-d]pyrimidine (22.62 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 175 (18.48 g, yield 64%).  $[M+H]=628$

## SYNTHESIS EXAMPLE 23



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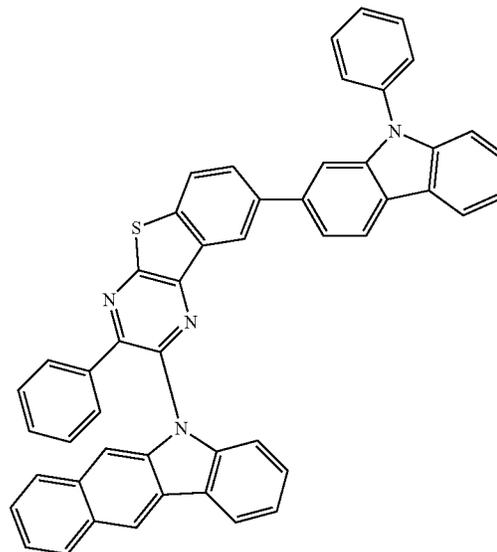
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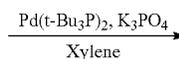
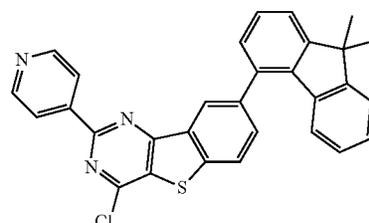
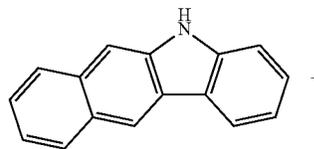
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182

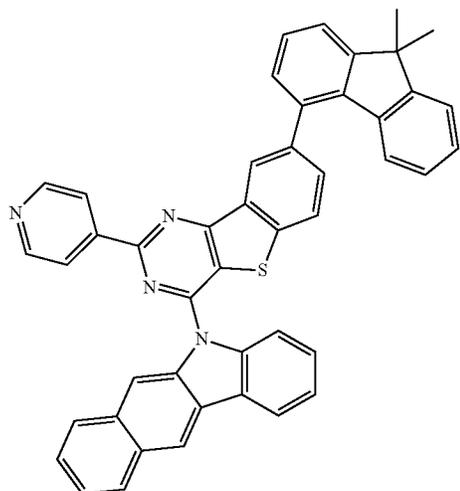
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-phenyl-8-(9-phenyl-9H-carbazol-2-yl)benzo[4,5]thieno[2,3-b]pyrazine (27.24 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 182 (21.17 g, yield 64%).  $[M+H]=719$

## SYNTHESIS EXAMPLE 24



**381**

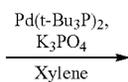
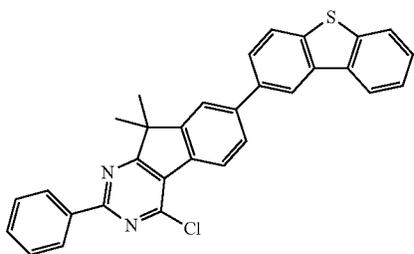
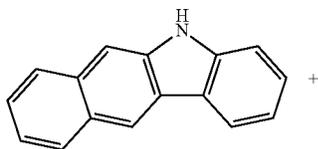
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194

Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-8-(9,9-dimethyl-9H-fluoren-4-yl)-2-(pyridin-4-yl)benzo[4,5]thieno[3,2-d]pyrimidine (24.80 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 194 (19.14 g, yield 62%).  $[M+H]=671$

## SYNTHESIS EXAMPLE 25



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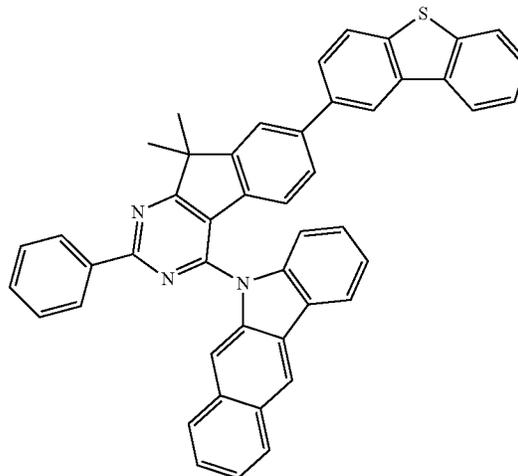
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**382**

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201

Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-7-(dibenzo[b,d]thiophen-2-yl)-9,9-dimethyl-2-phenyl-9H-indeno[2,1-d]pyrimidine (24.75 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 201 (20.65 g, yield 67%).  $[M+H]=670$

## SYNTHESIS EXAMPLE 26

40

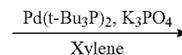
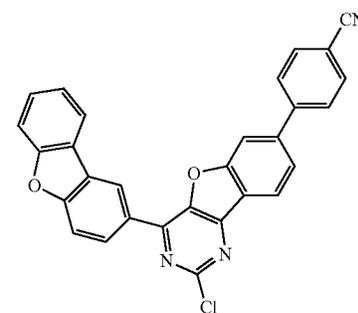
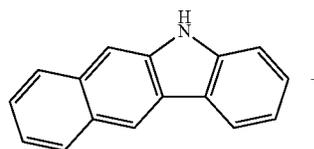
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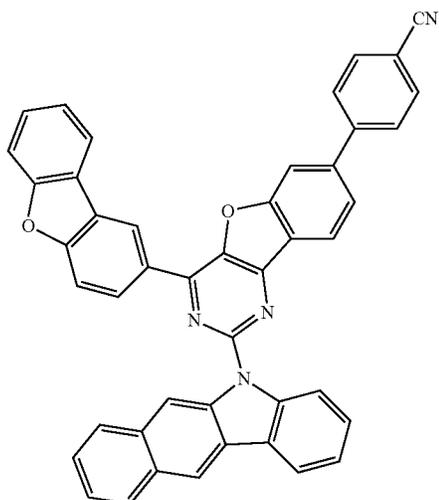
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383

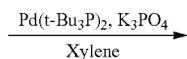
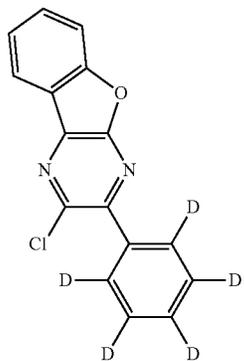
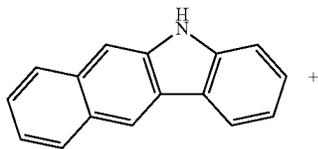
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214

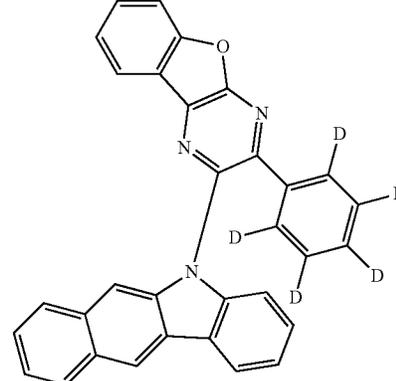
Chemical Formula a (10.0 g, 1.0 eq.), 4-(2-chloro-4-(dibenzo[b,d]furan-2-yl)benzofuro[3,2-d]pyrimidin-7-yl) benzonitrile (23.89 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 214 (19.52 g, yield 65%).  $[M+H]=653$

## SYNTHESIS EXAMPLE 27



384

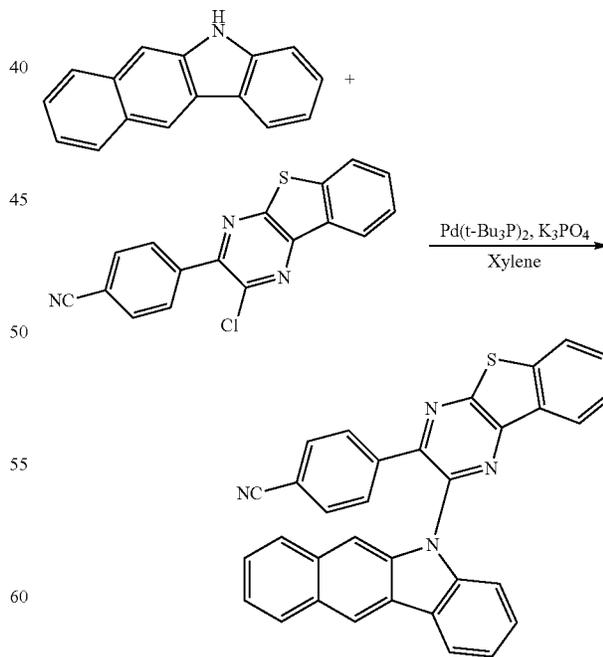
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217

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(phenyl-d5)benzofuro[2,3-b]pyrazine (14.46 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 217 (14.81 g, yield 69%).  $[M+H]=467$

## SYNTHESIS EXAMPLE 28



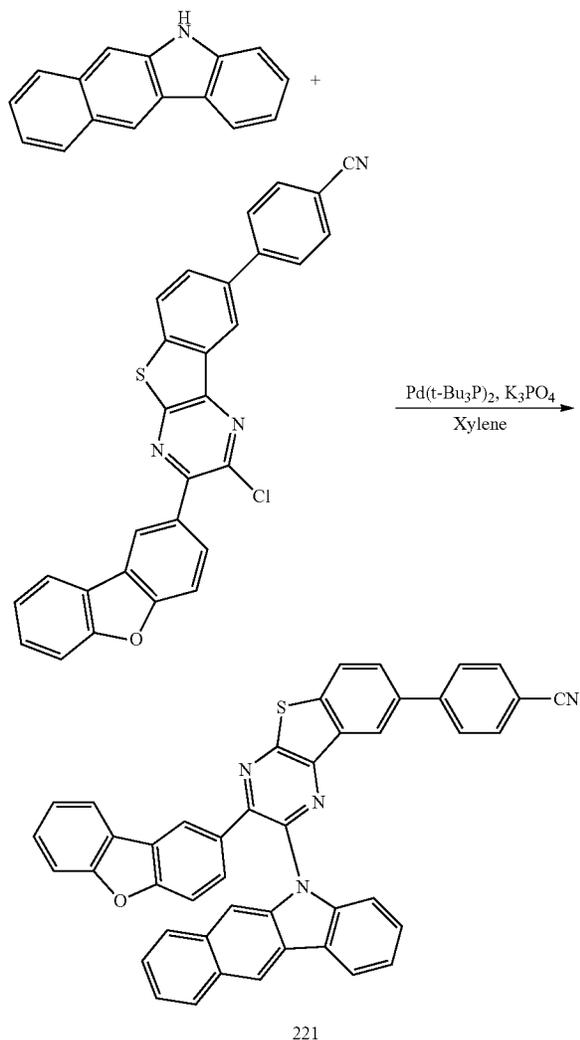
218

Chemical Formula a (10.0 g, 1.0 eq.), 4-(2-chlorobenzo[4,5]thieno[2,3-b]pyrazin-3-yl)benzonitrile (16.29 g, 1.1

385

eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 218 (15.73 g, yield 68%).  $[M+H]=503$

## SYNTHESIS EXAMPLE 29

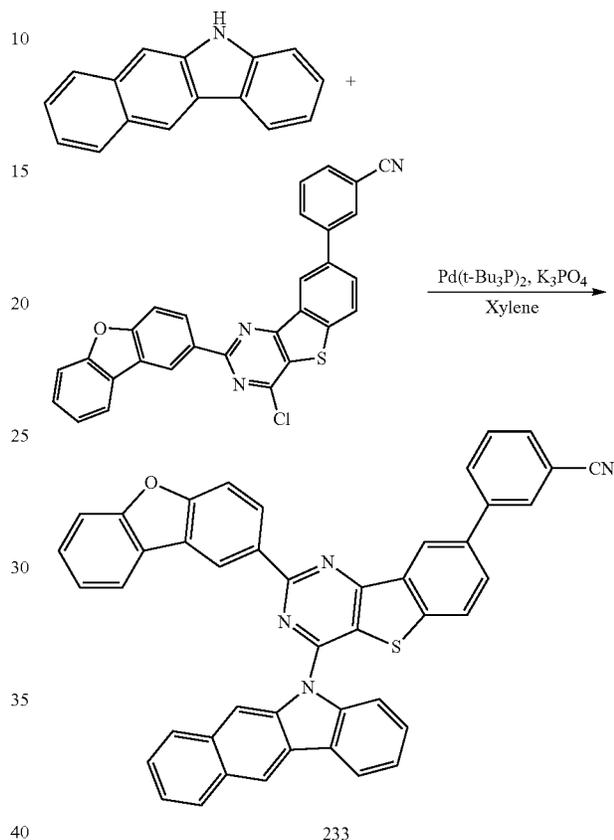


Chemical Formula a (10.0 g, 1.0 eq.), 4-(2-chloro-3-(dibenzo[b,d]furan-2-yl)benzo[4,5]thieno[2,3-b]pyrazin-8-yl)benzonitrile (24.80 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while

386

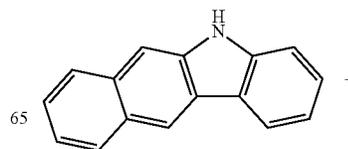
adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 221 (20.62 g, yield 67%).  $[M+H]=669$

## SYNTHESIS EXAMPLE 30



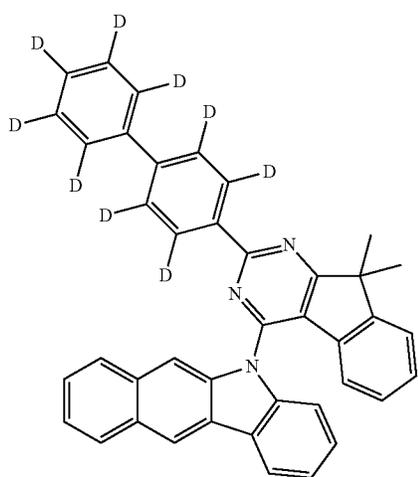
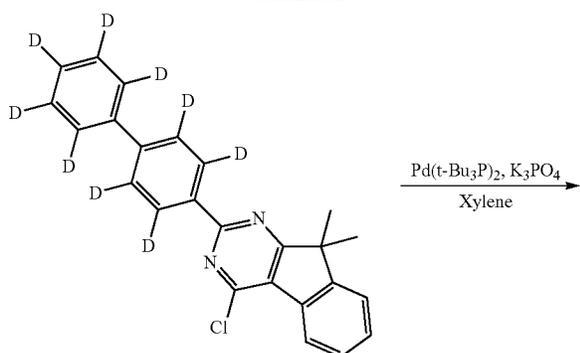
Chemical Formula a (10.0 g, 1.0 eq.), 3-(4-chloro-2-(dibenzo[b,d]furan-2-yl)benzo[4,5]thieno[3,2-d]pyrimidin-8-yl)benzonitrile (24.70 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 233 (20.93 g, yield 68%).  $[M+H]=669$

## SYNTHESIS EXAMPLE 31



**387**

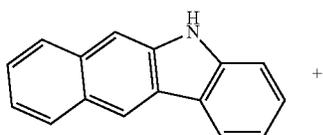
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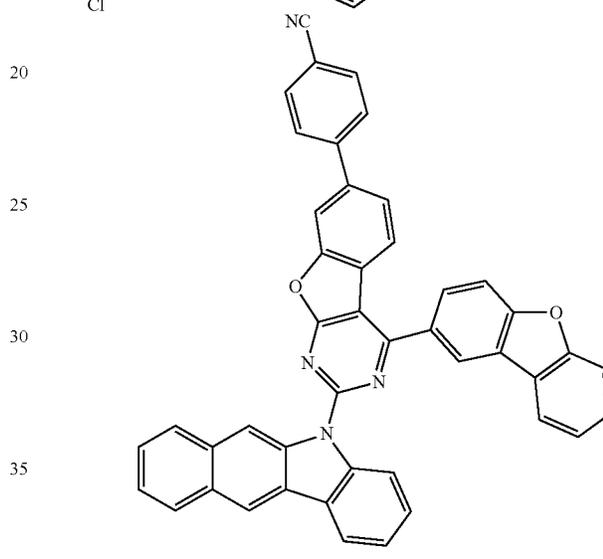
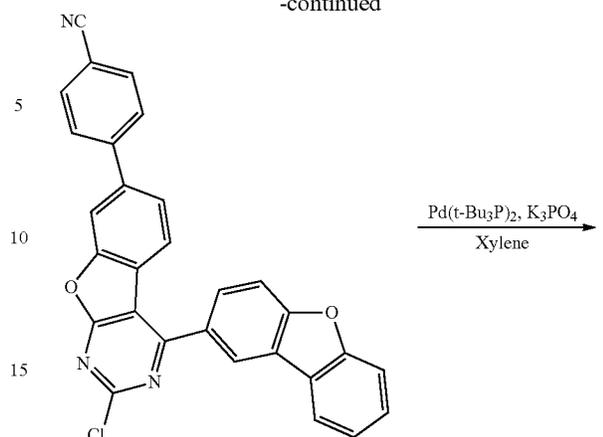
237

Chemical Formula a (10.0 g, 1.0 eq.), 2-([1,1'-biphenyl]-4-yl-d9)-4-chloro-9,9-dimethyl-9H-indeno[2,1-d]pyrimidine (19.84 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 237 (17.92 g, yield 68%).  $[M+H]=573$

## SYNTHESIS EXAMPLE 32

**388**

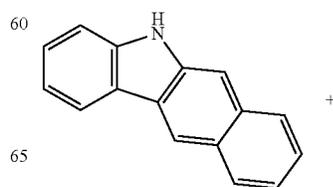
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244

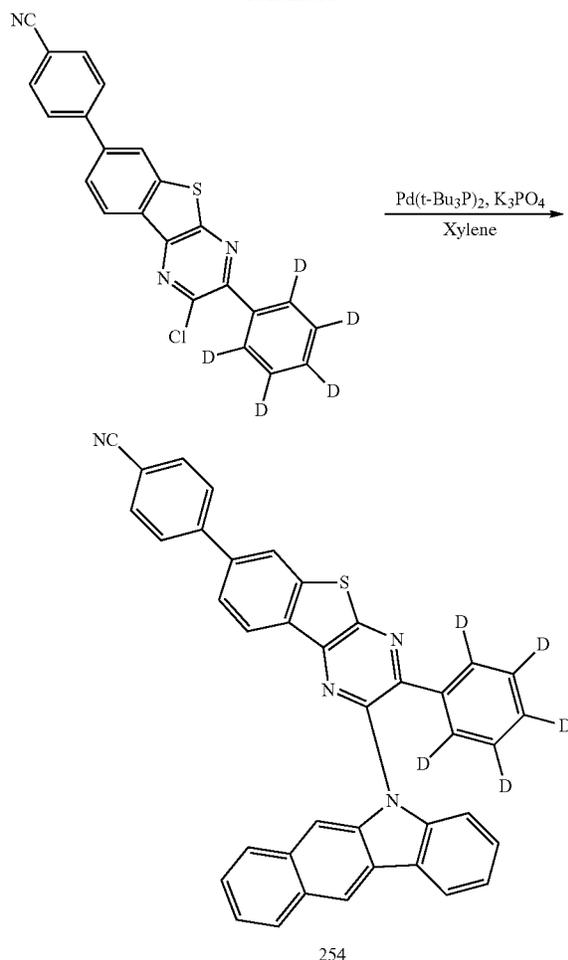
Chemical Formula a (10.0 g, 1.0 eq.), 4-(2-chloro-4-(dibenzo[b,d]furan-2-yl)benzofuro[2,3-d]pyrimidin-7-yl)benzonitrile (23.89 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 244 (19.52 g, yield 65%).  $[M+H]=574$

## SYNTHESIS EXAMPLE 33



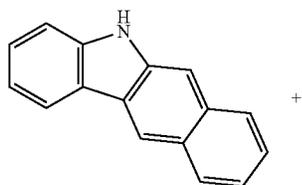
389

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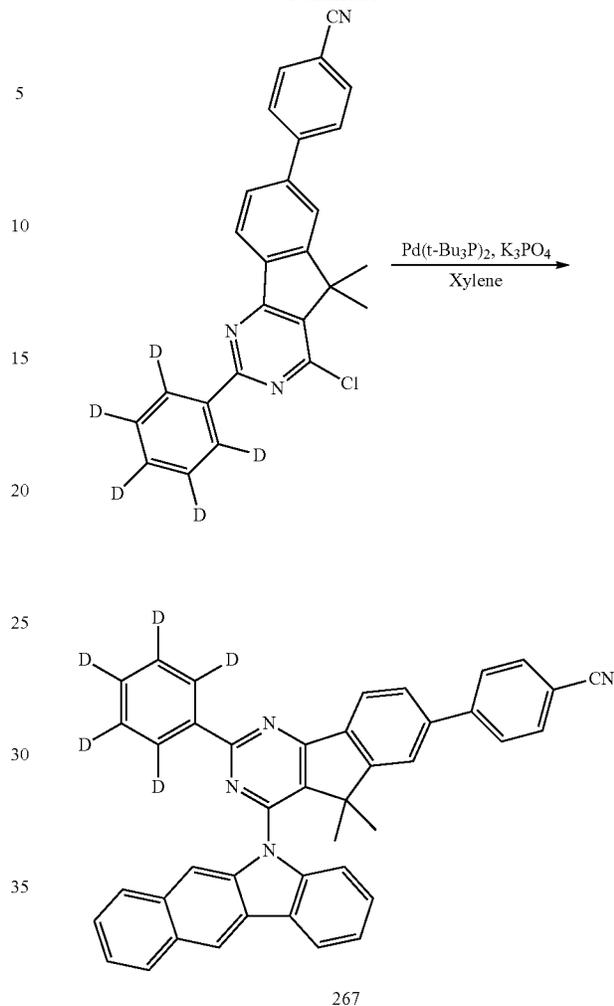
Chemical Formula a (10.0 g, 1.0 eq.), 4-(2-chloro-3-(phenyl-d5)benzo[4,5]thieno[2,3-b]pyrazin-7-yl)benzotrile (20.39 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 254 (18.00 g, yield 67%).  $[M+H]=584$

## SYNTHESIS EXAMPLE 34



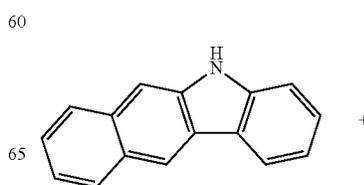
390

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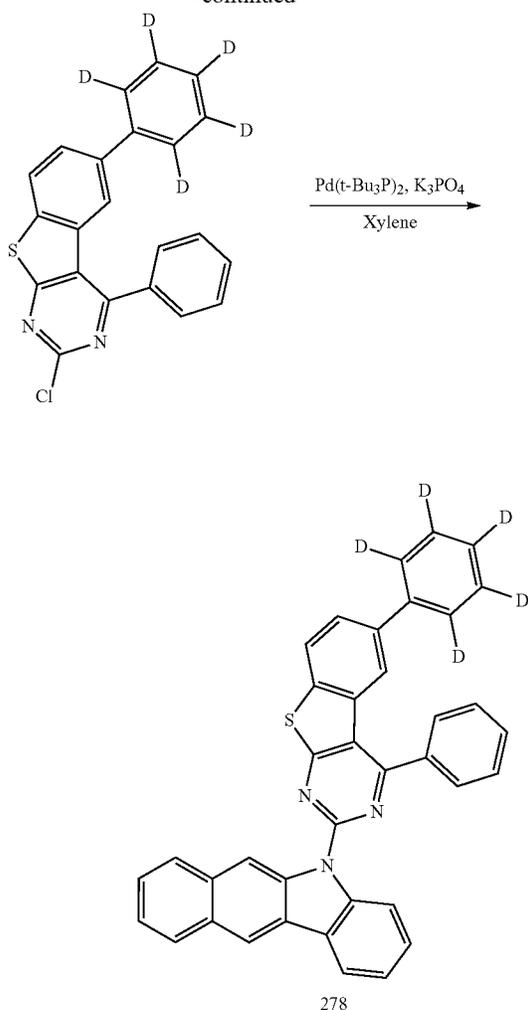
Chemical Formula a (10.0 g, 1.0 eq.), 4-(4-chloro-5,5-dimethyl-2-(phenyl-d5)-5H-indeno[1,2-d]pyrimidin-7-yl)benzotrile (20.90 g, 1.1 eq.),  $K_3PO_4$  (15.88 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 267 (17.76 g, yield 65%).  $[M+H]=594$

## SYNTHESIS EXAMPLE 35



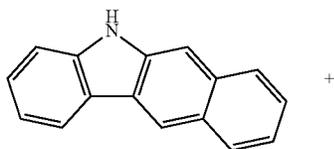
391

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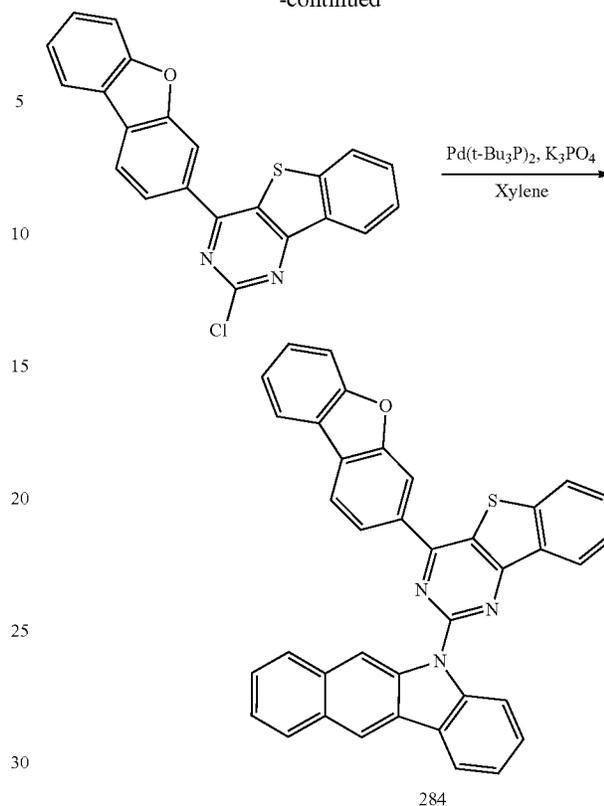
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-phenyl-6-(phenyl-d5)benzo[4,5]thieno[2,3-d]pyrimidine (19.13 g, 1.1 eq.),  $\text{K}_3\text{PO}_4$  (15.88 g, 2.0 eq.) and  $\text{Pd}(\text{t-Bu}_3\text{P})_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 278 (17.48 g, yield 68%).  $[\text{M}+\text{H}]^+=559$

## SYNTHESIS EXAMPLE 36



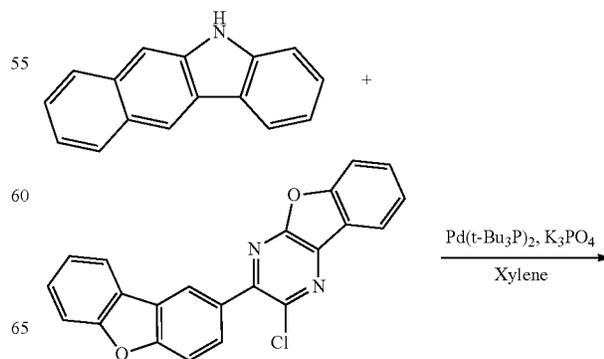
392

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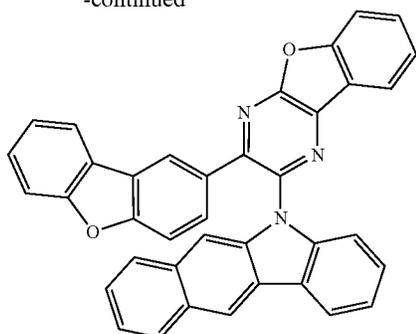
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(dibenzo [b,d]furan-3-yl)benzo[4,5]thieno[3,2-d]pyrimidine (19.58 g, 1.1 eq.),  $\text{K}_3\text{PO}_4$  (15.88 g, 2.0 eq.) and  $\text{Pd}(\text{t-Bu}_3\text{P})_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 284 (16.72 g, yield 64%).  $[\text{M}+\text{H}]^+=568$

## SYNTHESIS EXAMPLE 37



393

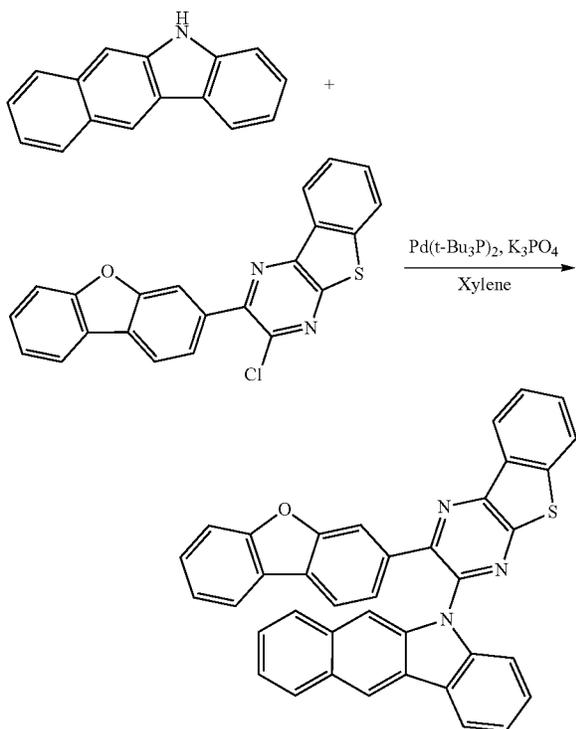
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292

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(dibenzo [b,d]furan-2-yl)benzofuro[2,3-b]pyrazine (18.77 g, 1.1 eq.),  $K_3PO_4$  (15.88 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 292 (17.01 g, yield 67%).  $[M+H]=552$

## SYNTHESIS EXAMPLE 38



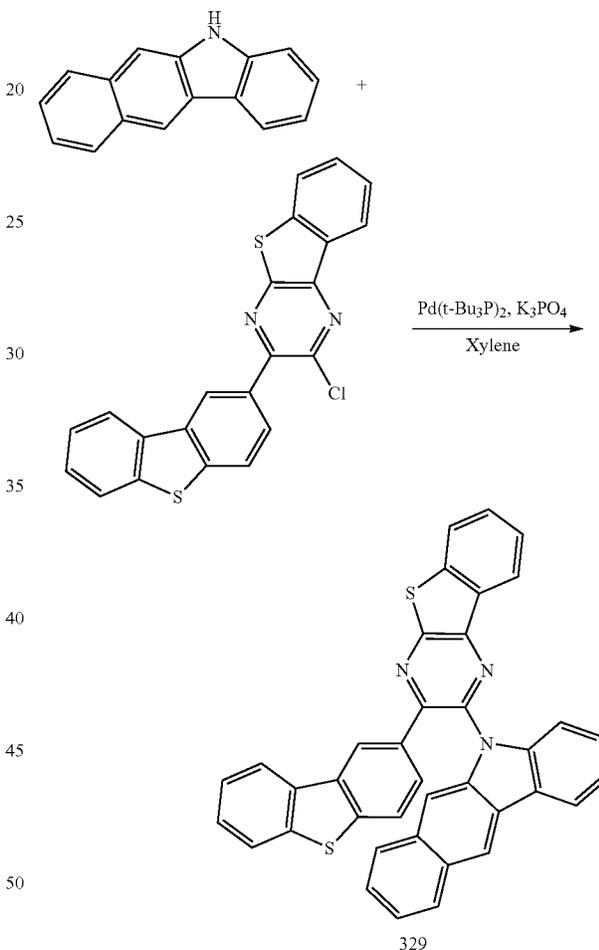
296

Chemical Formula a (10.0 g, 1.0 eq.), 3-chloro-2-(dibenzo [b,d]furan-3-yl)benzo[4,5]thieno[2,3-b]pyrazine (19.58 g,

394

1.1 eq.),  $K_3PO_4$  (15.88 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 296 (16.98 g, yield 65%).  $[M+H]=568$

## SYNTHESIS EXAMPLE 39

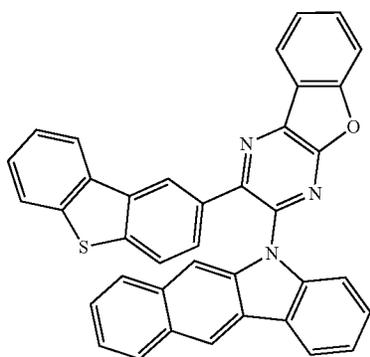
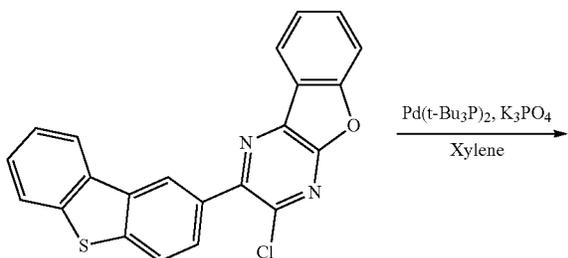
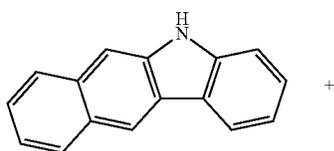


329

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(dibenzo [b,d]thiophen-2-yl)benzo[4,5]thieno[2,3-b]pyrazin (20.39 g, 1.1 eq.),  $K_3PO_4$  (15.88 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 329 (17.73 g, yield 66%).  $[M+H]=584$

## 395

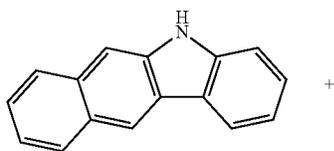
## SYNTHESIS EXAMPLE 40



334

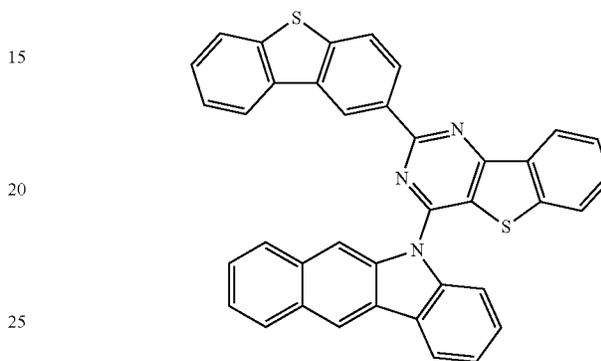
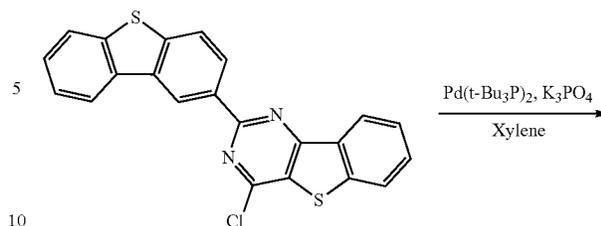
Chemical Formula a (10.0 g, 1.0 eq.), 3-chloro-2-(dibenzo [b,d]thiophen-2-yl)benzofuro[2,3-b]pyrazine (19.58 g, 1.1 eq.),  $K_3PO_4$  (15.88 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 334 (17.50 g, yield 67%).  $[M+H]=568$

## SYNTHESIS EXAMPLE 41



## 396

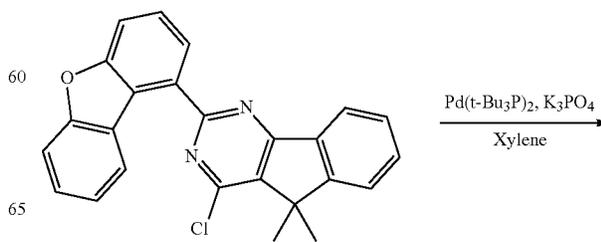
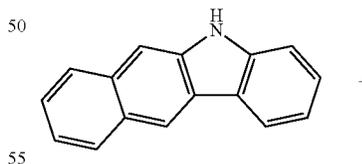
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341

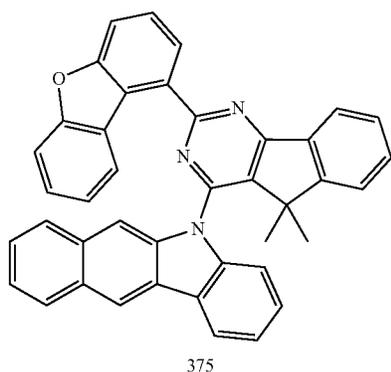
Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(dibenzo [b,d]thiophen-2-yl)benzo[4,5]thieno[3,2-d]pyrimidine (20.39 g, 1.1 eq.),  $K_3PO_4$  (15.88 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 341 (17.46 g, yield 65%).  $[M+H]=584$

## SYNTHESIS EXAMPLE 42



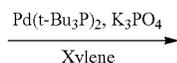
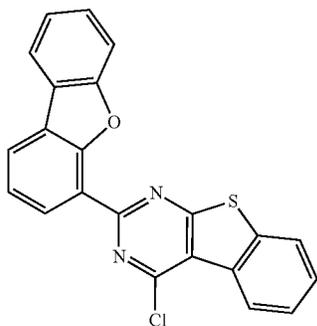
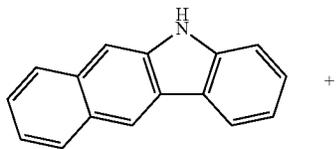
397

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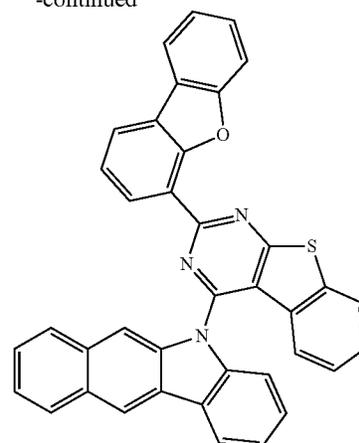
Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(dibenzo [b,d]furan-1-yl)-5,5-dimethyl-5H-indeno[1,2-d]pyrimidine (20.09 g, 1.1 eq.),  $K_3PO_4$  (15.88 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 375 (17.81 g, yield 67%).  $[M+H]=578$

## SYNTHESIS EXAMPLE 43



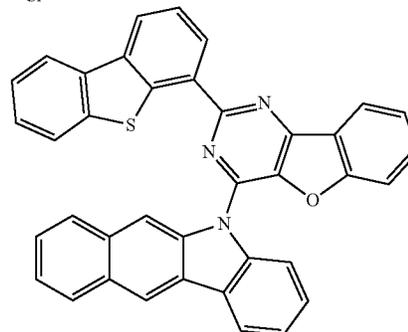
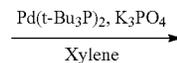
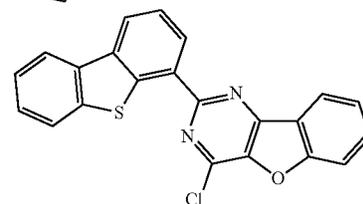
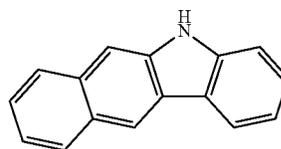
398

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Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(dibenzo [b,d]furan-4-yl)benzo[4,5]thieno[2,3-d]pyrimidine (19.58 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 383 (17.50 g, yield 67%).  $[M+H]=568$

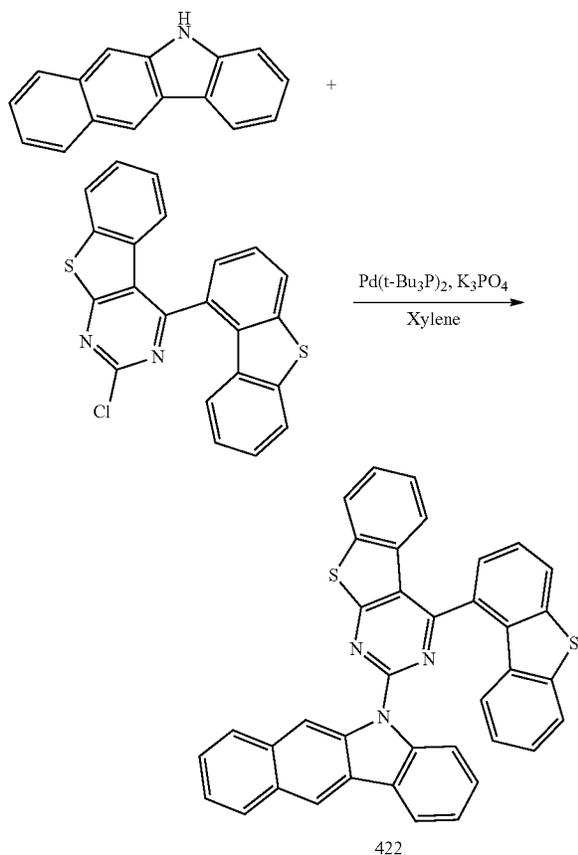
## SYNTHESIS EXAMPLE 44



## 399

Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(dibenzo[b,d]thiophen-4-yl)benzofuro[3,2-d]pyrimidine (17.25 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 412 (16.98 g, yield 65%).  $[M+H]=568$

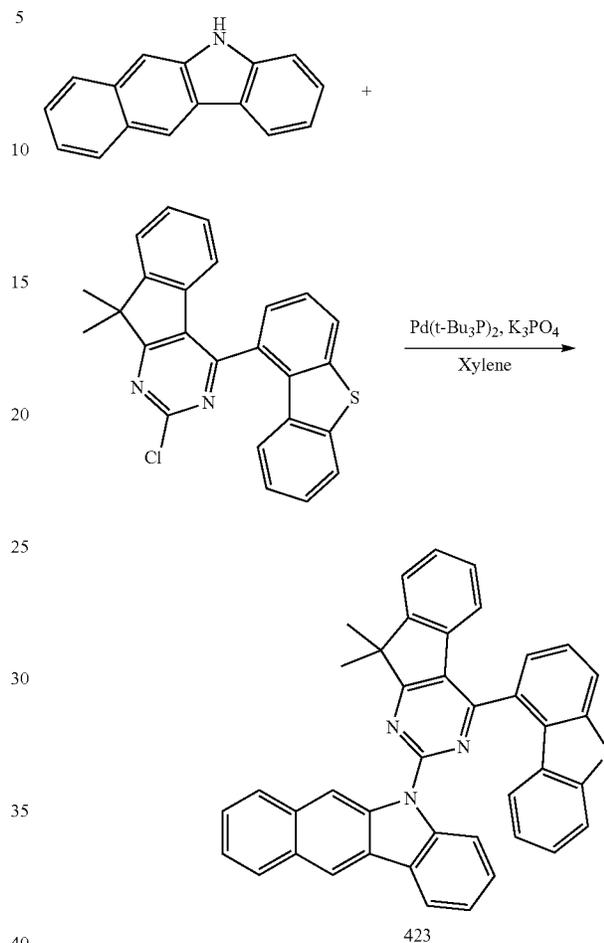
## SYNTHESIS EXAMPLE 45



Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(dibenzo[b,d]thiophen-1-yl)benzo[4,5]thieno[2,3-d]pyrimidine (20.39 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 422 (18.26 g, yield 68%).  $[M+H]=584$

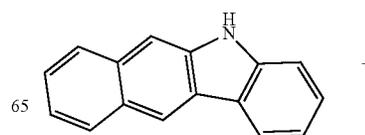
## 400

## SYNTHESIS EXAMPLE 46



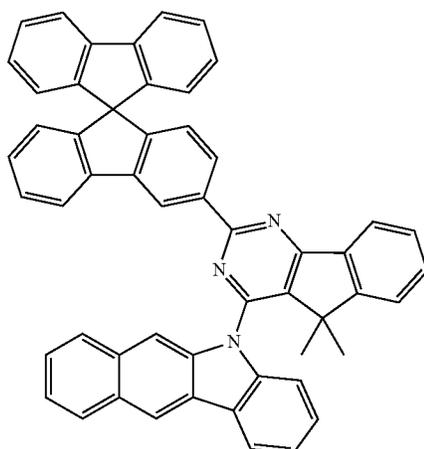
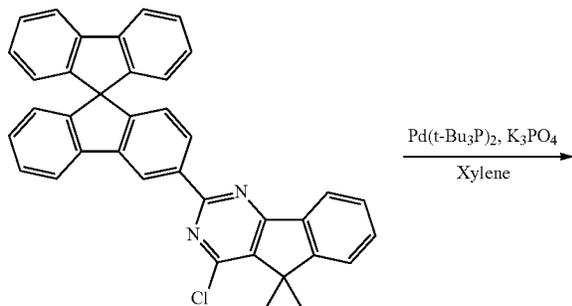
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(dibenzo[b,d]thiophen-1-yl)-9,9-dimethyl-9H-indeno[2,1-d]pyrimidine (20.90 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 423 (19.12 g, yield 70%).  $[M+H]=594$

## SYNTHESIS EXAMPLE 47



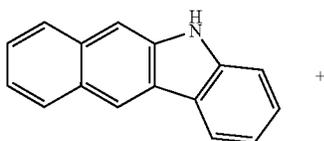
401

-continued



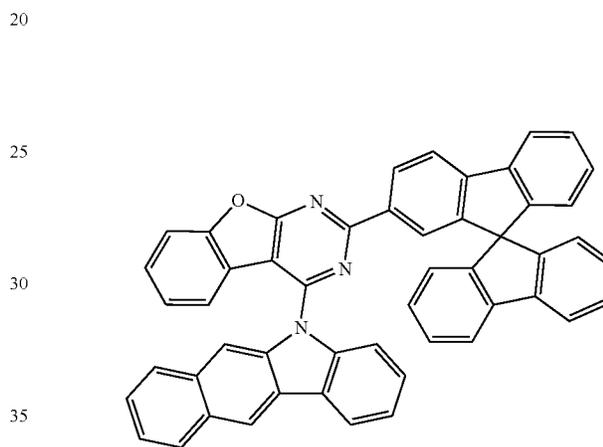
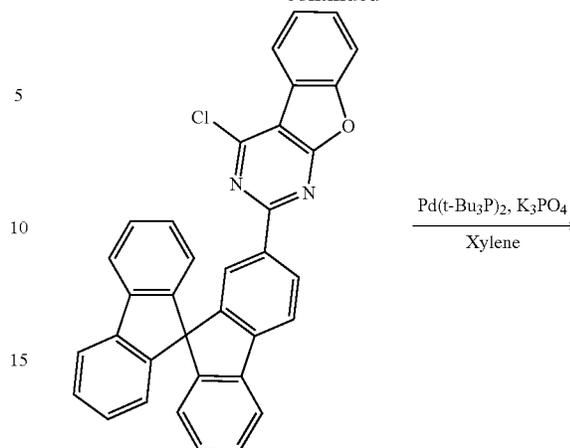
Chemical Formula a (10.0 g, 1.0 eq.), 2-(9,9'-spirobi[fluorene]-3-yl)-4-chloro-5,5-dimethyl-5H-indeno[1,2-d]pyrimidine (27.59 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 450 (22.71 g, yield 68%). [M+H]<sup>+</sup>=726

## SYNTHESIS EXAMPLE 48



402

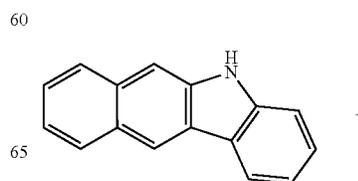
-continued



Chemical Formula a (10.0 g, 1.0 eq.), 2-(9,9'-spirobi[fluorene]-2-yl)-4-chlorobenzofuro[2,3-d]pyrimidine (26.27 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 451 (22.22 g, yield 69%). [M+H]<sup>+</sup>=700

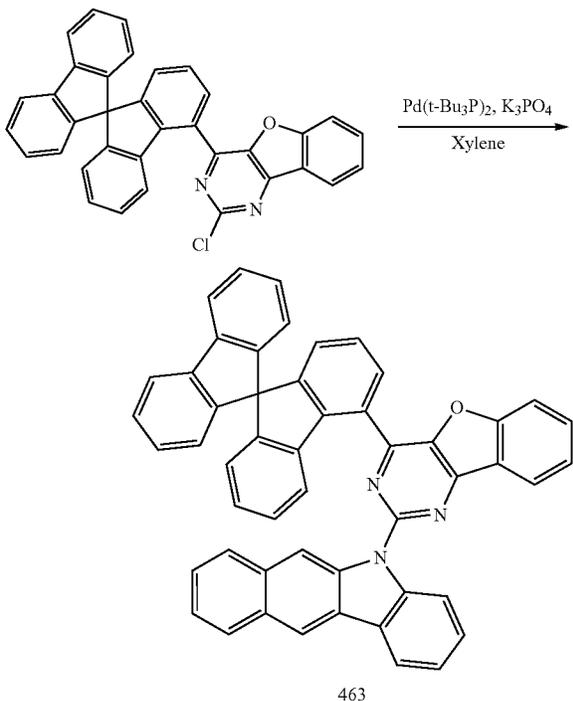
FIG. 8 is a graph showing a 1H-NMR value of Chemical Formula 451.

## SYNTHESIS EXAMPLE 49



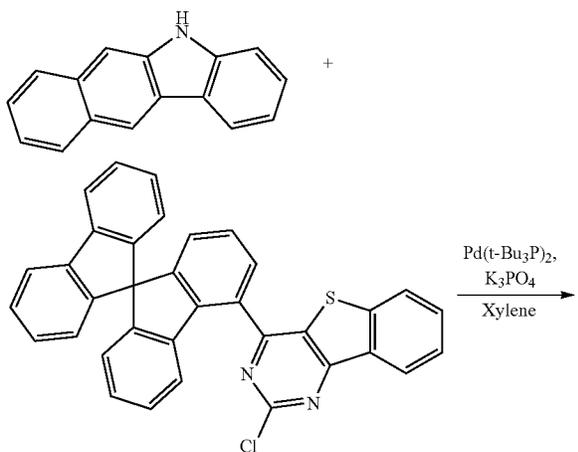
403

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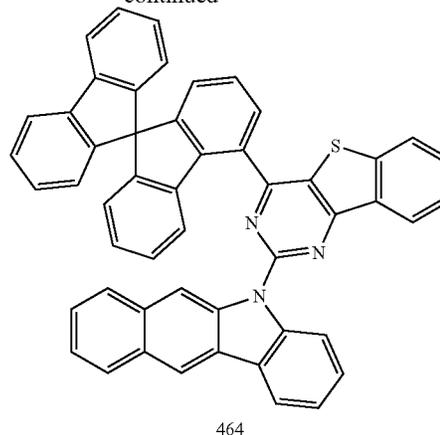
Chemical Formula a (10.0 g, 1.0 eq.), 4-(9,9'-spiro[fluorene]-4-yl)-2-chlorobenzofuro[3,2-d]pyrimidine (26.27 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 463 (20.93 g, yield 65%).  $[M+H]=700$

## SYNTHESIS EXAMPLE 50



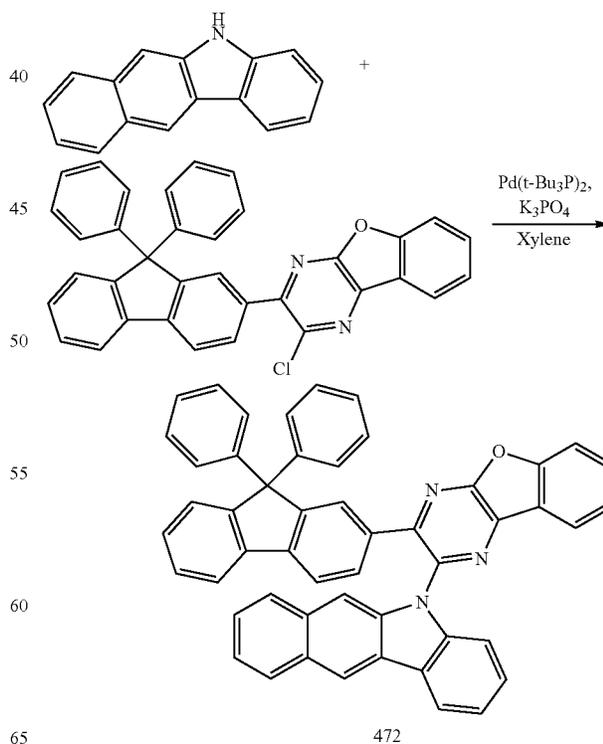
404

-continued



Chemical Formula a (10.0 g, 1.0 eq.), 4-(9,9'-spiro[fluorene]-4-yl)-2-chlorobenzothieno[3,2-d]pyrimidine (27.08 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 464 (22.07 g, yield 67%).  $[M+H]=716$

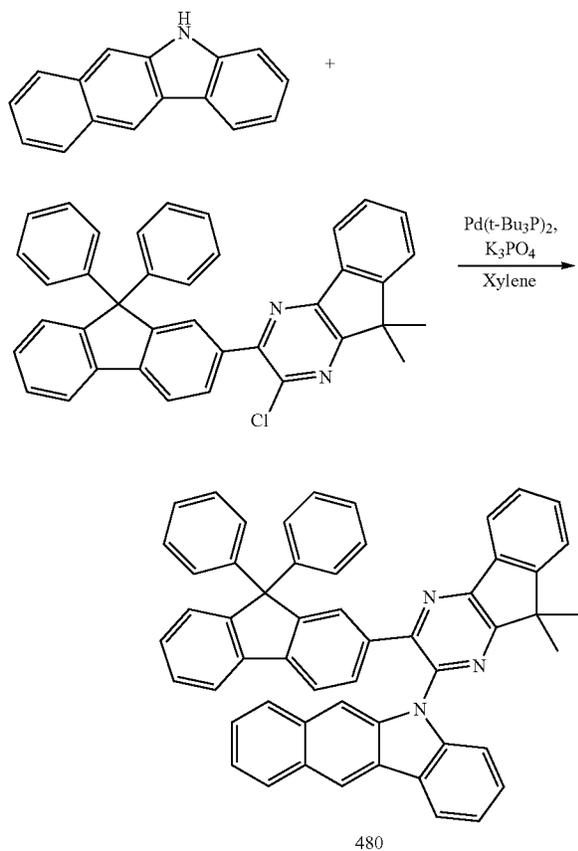
## SYNTHESIS EXAMPLE 51



## 405

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(9,9-diphenyl-9H-fluoren-2-yl)benzofuro[2,3-b]pyrazine (26.37 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 472 (21.64 g, yield 67%).  $[M+H]=702$

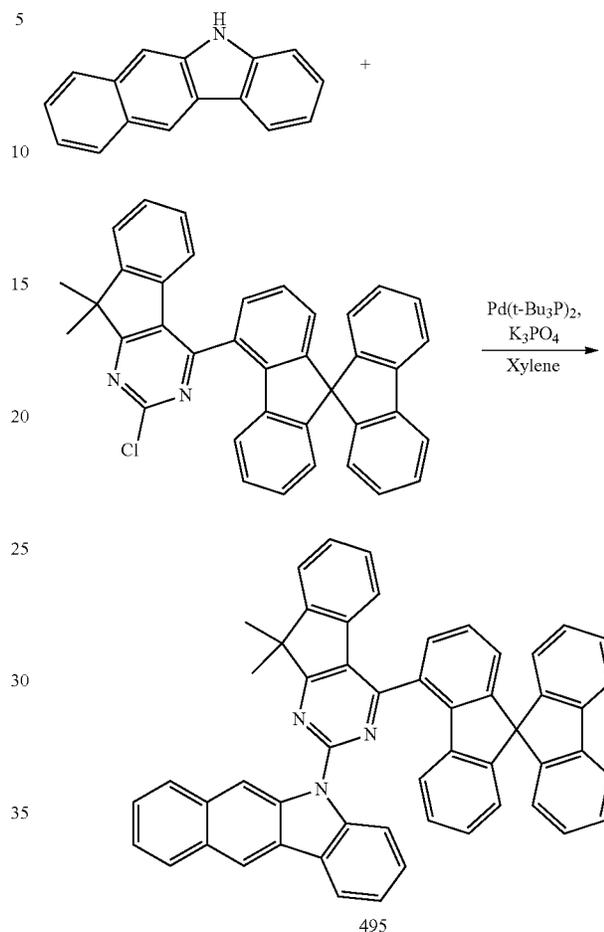
## SYNTHESIS EXAMPLE 52



Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(9,9-diphenyl-9H-fluoren-2-yl)-9,9-dimethyl-9H-indeno[1,2-b]pyrazine (27.69 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 480 (23.11 g, yield 69%).  $[M+H]=728$

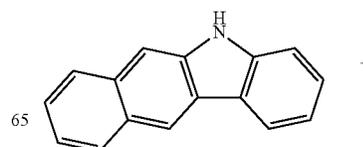
## 406

## SYNTHESIS EXAMPLE 53



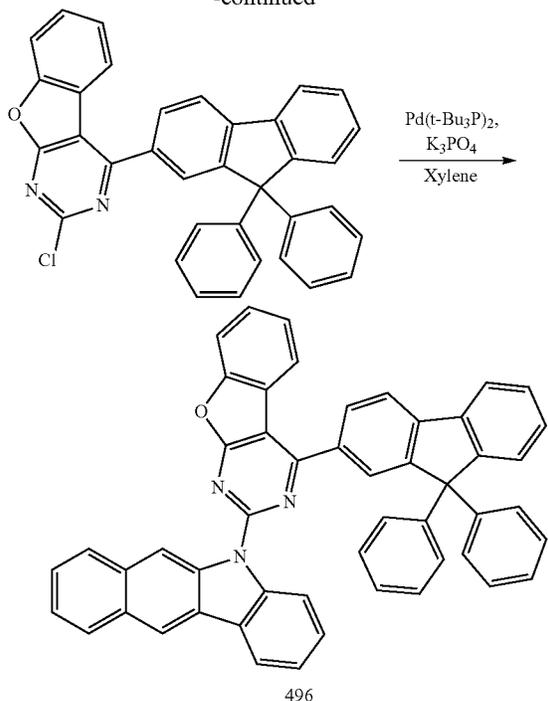
Chemical Formula a (10.0 g, 1.0 eq.), 4-(9,9'-spirobi[fluoren]-4-yl)-2-chloro-9,9-dimethyl-9H-indeno[2,1-d]pyrimidine (27.59 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 495 (23.72 g, yield 71%).  $[M+H]=726$

## SYNTHESIS EXAMPLE 54



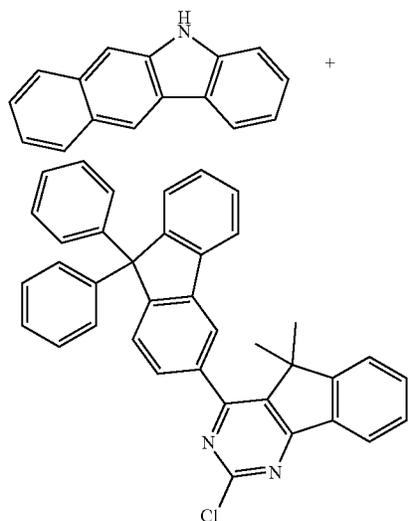
407

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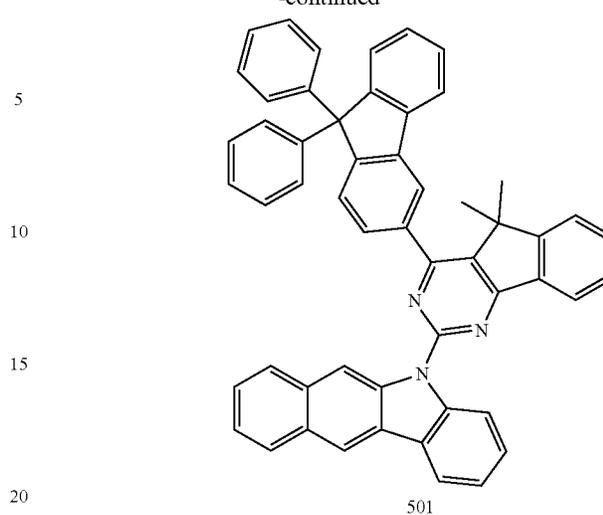
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(9,9-diphenyl-9H-fluoren-2-yl)benzofuro[2,3-d]pyrimidine (26.37 g, 1.1 eq.),  $\text{K}_3\text{PO}_4$  (19.53 g, 2.0 eq.) and  $\text{Pd}(t\text{-Bu}_3\text{P})_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 496 (22.61 g, yield 70%).  $[\text{M}+\text{H}]^+=702$

## SYNTHESIS EXAMPLE 55



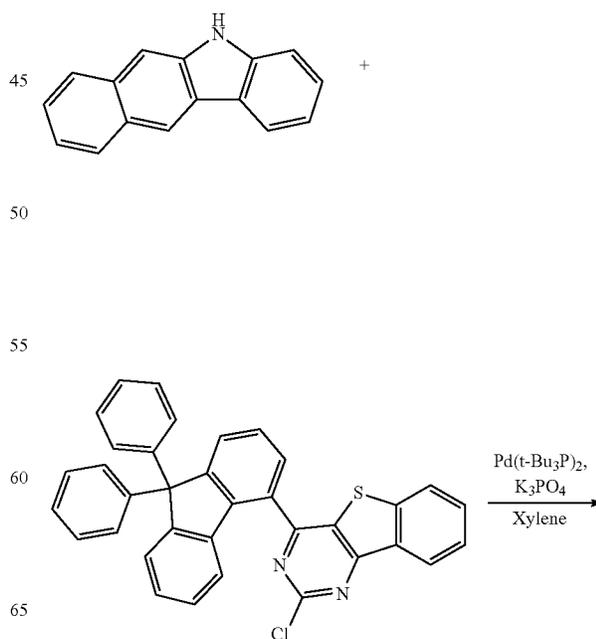
408

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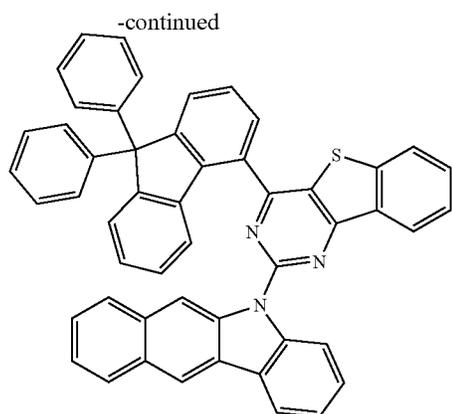


Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(9,9-diphenyl-9H-fluoren-3-yl)-5,5-dimethyl-5H-indeno[1,2-d]pyrimidine (27.69 g, 1.1 eq.),  $\text{K}_3\text{PO}_4$  (19.53 g, 2.0 eq.) and  $\text{Pd}(t\text{-Bu}_3\text{P})_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 501 (24.12 g, yield 72%).  $[\text{M}+\text{H}]^+=728$

## SYNTHESIS EXAMPLE 56



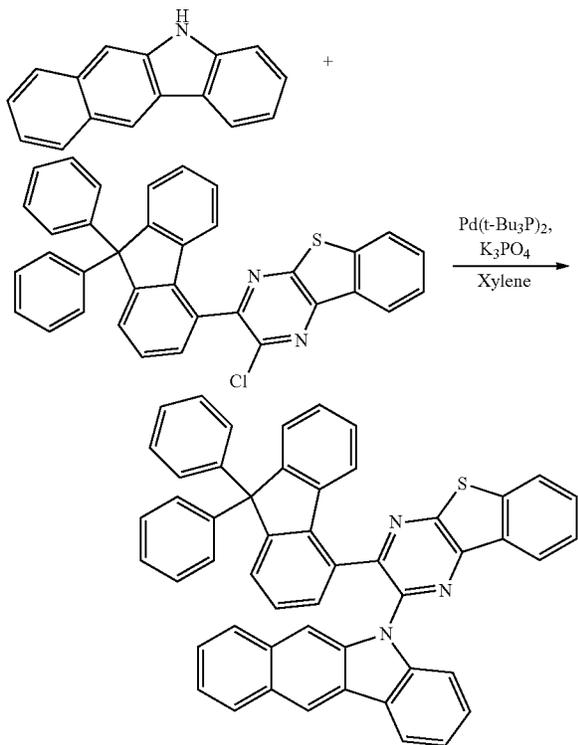
409



503

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(9,9-diphenyl-9H-fluoren-4-yl)benzo[4,5]thieno[3,2-d]pyrimidine (27.19 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 503 (23.12 g, yield 70%).  $[M+H]=718$

## SYNTHESIS EXAMPLE 57

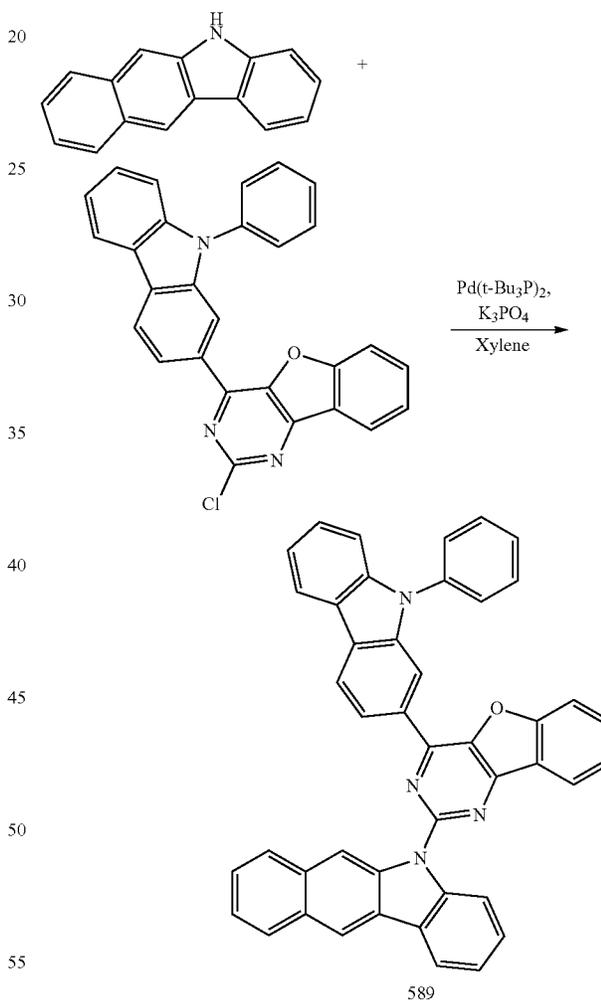


509

410

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(9,9-diphenyl-9H-fluoren-4-yl)benzo[4,5]thieno[2,3-b]pyrazine (27.19 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 509 (23.78 g, yield 72%).  $[M+H]=718$

## SYNTHESIS EXAMPLE 58



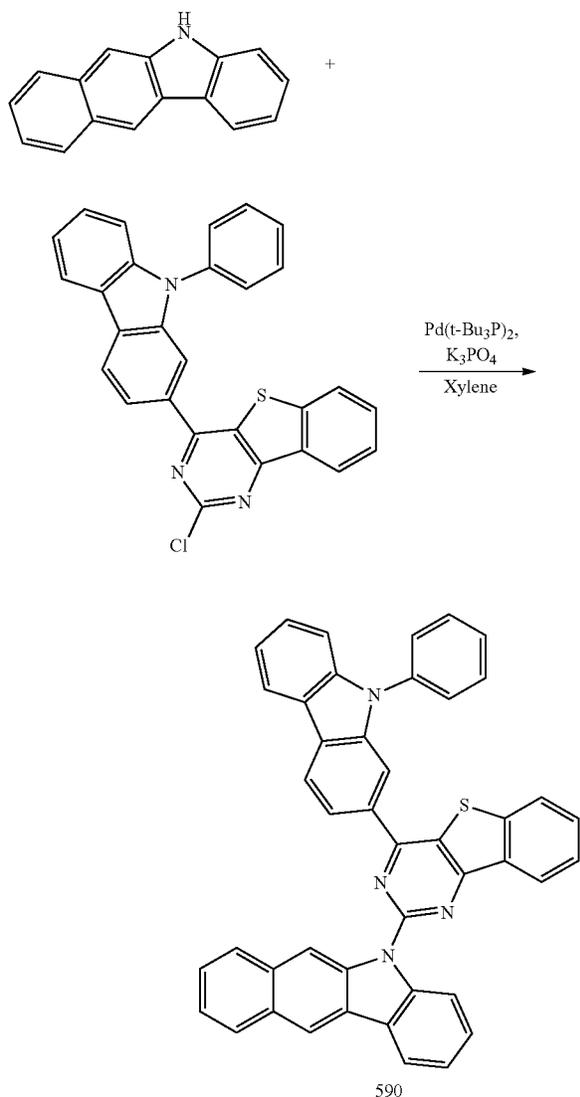
589

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(9-phenyl-9H-carbazol-2-yl)benzofuro[3,2-d]pyrimidine (22.57 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux

411

again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 589 (20.19 g, yield 70%). [M+H]=627

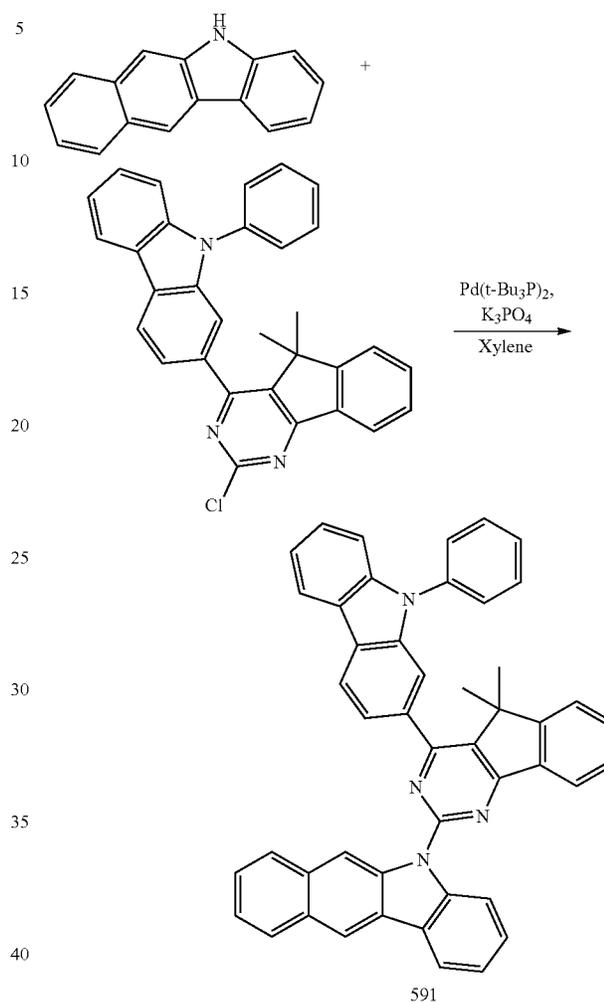
## SYNTHESIS EXAMPLE 59



Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(9-phenyl-9H-carbazol-2-yl)benzo[4,5]thieno[3,2-d]pyrimidine (23.38 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 590 (21.01 g, yield 71%). [M+H]=653

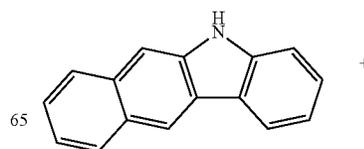
412

## SYNTHESIS EXAMPLE 60



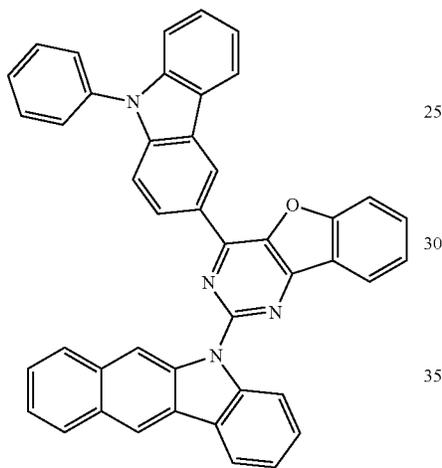
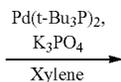
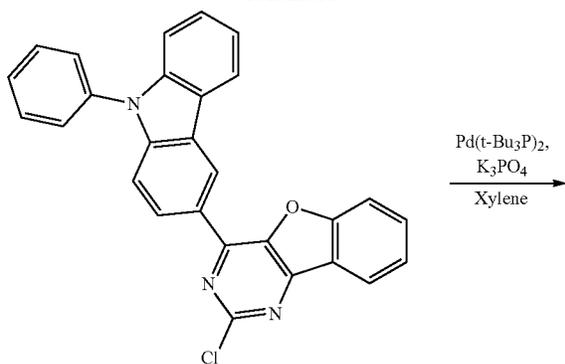
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-5,5-dimethyl-4-(9-phenyl-9H-carbazol-2-yl)-5H-indeno[1,2-d]pyrimidine (23.89 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 591 (20.43 g, yield 68%). [M+H]=653

## SYNTHESIS EXAMPLE 61



413

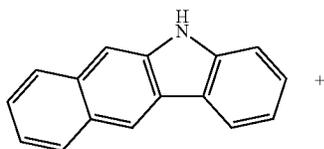
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592

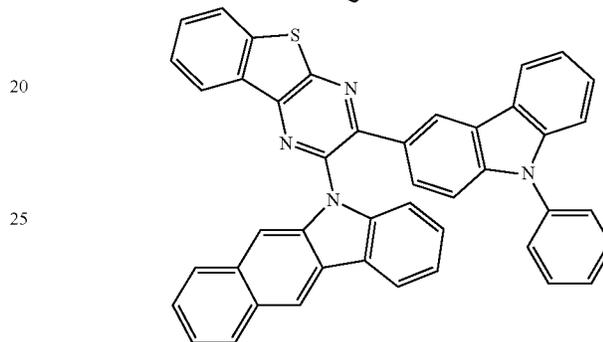
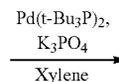
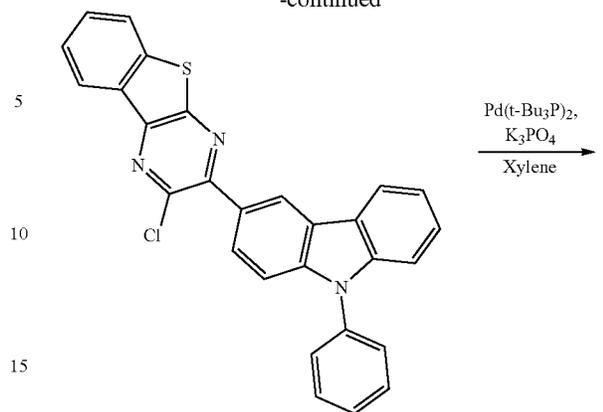
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(9-phenyl-9H-carbazol-3-yl)benzofuro[3,2-d]pyrimidine (22.57 g, 1.1 eq.),  $\text{K}_3\text{PO}_4$  (19.53 g, 2.0 eq.) and  $\text{Pd(t-Bu}_3\text{P)}_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 592 (20.19 g, yield 70%).  $[\text{M}+\text{H}] = 627$

## SYNTHESIS EXAMPLE 62



414

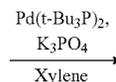
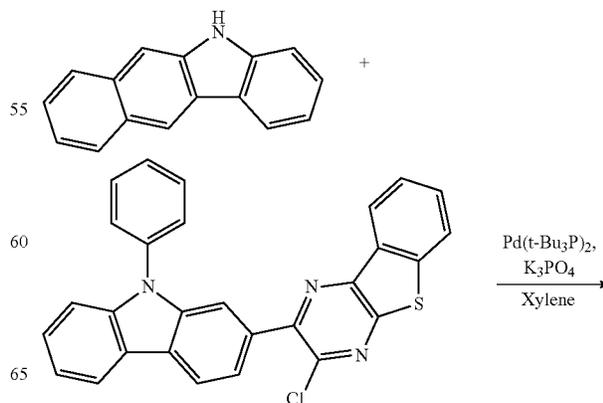
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599

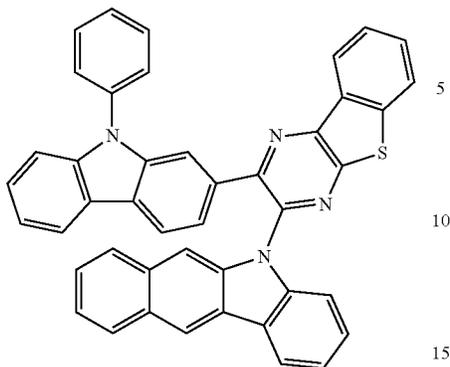
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-3-(9-phenyl-9H-carbazol-3-yl)benzo[4,5]thieno[2,3-b]pyrazine (23.38 g, 1.1 eq.),  $\text{K}_3\text{PO}_4$  (19.53 g, 2.0 eq.) and  $\text{Pd(t-Bu}_3\text{P)}_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $\text{CHCl}_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 599 (21.00 g, yield 71%).  $[\text{M}+\text{H}] = 643$

## SYNTHESIS EXAMPLE 63



415

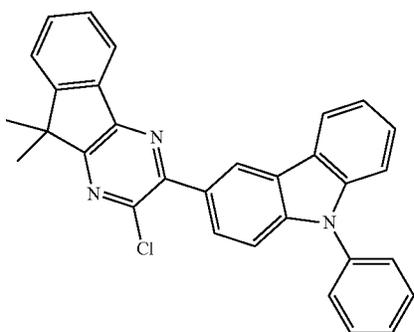
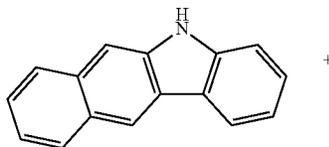
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602

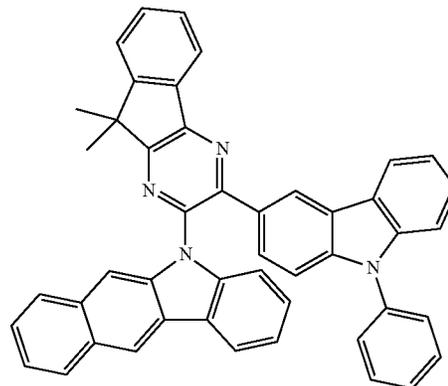
Chemical Formula a (10.0 g, 1.0 eq.), 3-chloro-2-(9-phenyl-9H-carbazol-2-yl)benzo[4,5]thieno[2,3-b]pyrazine (23.38 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 602 (21.00 g, yield 71%).  $[M+H]=643$

## SYNTHESIS EXAMPLE 64



416

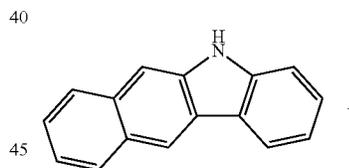
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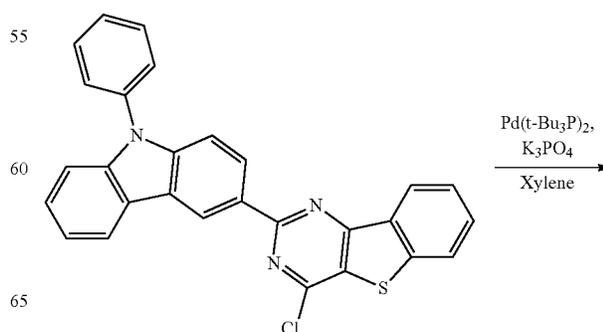
606

Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-9,9-dimethyl-3-(9-phenyl-9H-carbazol-3-yl)-9H-indeno[1,2-b]pyrazine (23.89 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 606 (20.43 g, yield 68%).  $[M+H]=653$

## SYNTHESIS EXAMPLE 65



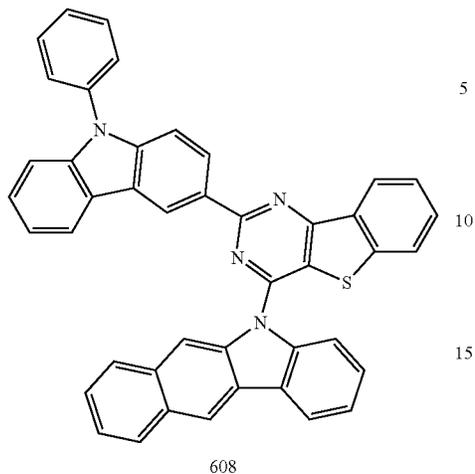
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65

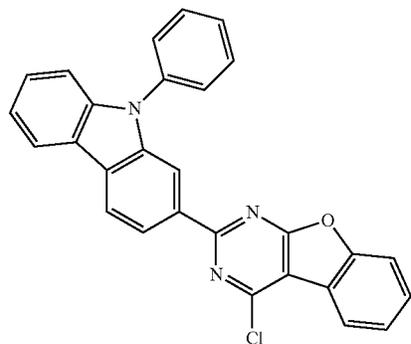
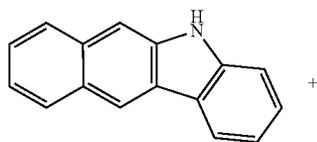
417

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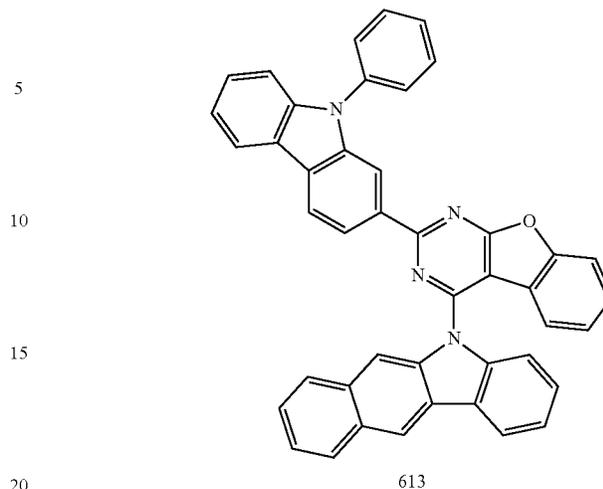
Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(9-phenyl-9H-carbazol-3-yl)benzo[4,5]thieno[3,2-d]pyrimidine (23.38 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 608 (19.22 g, yield 65%).  $[M+H]=643$

## SYNTHESIS EXAMPLE 66



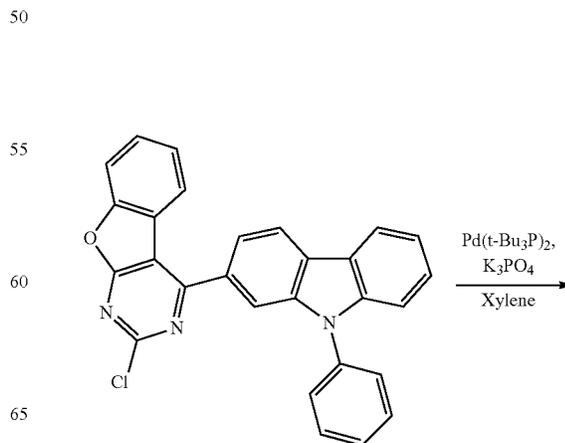
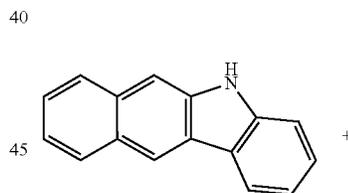
418

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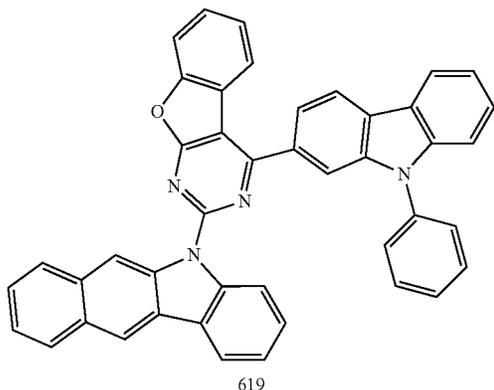
Chemical Formula a (10.0 g, 1.0 eq.), 4-chloro-2-(9-phenyl-9H-carbazol-2-yl)benzofuro[2,3-d]pyrimidine (22.57 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 613 (18.74 g, yield 65%).  $[M+H]=627$

## SYNTHESIS EXAMPLE 67



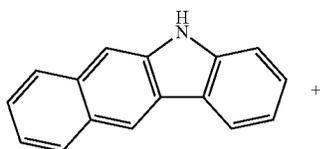
419

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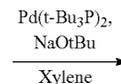
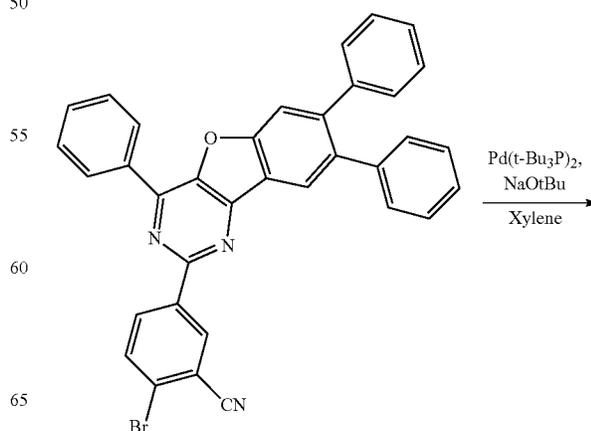
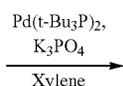
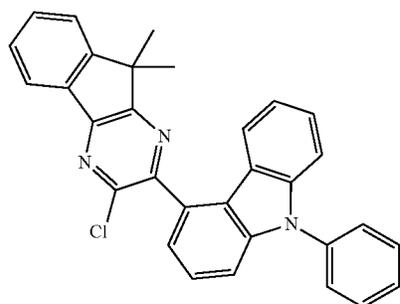
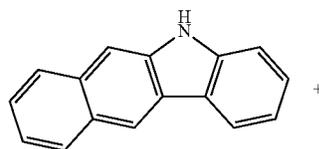
Chemical Formula a (10.0 g, 1.0 eq.), 2-chloro-4-(9-phenyl-9H-carbazol-2-yl)benzofuro[2,3-d]pyrimidine (22.57 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 619 (19.32 g, yield 67%).  $[M+H]=627$

## SYNTHESIS EXAMPLE 68



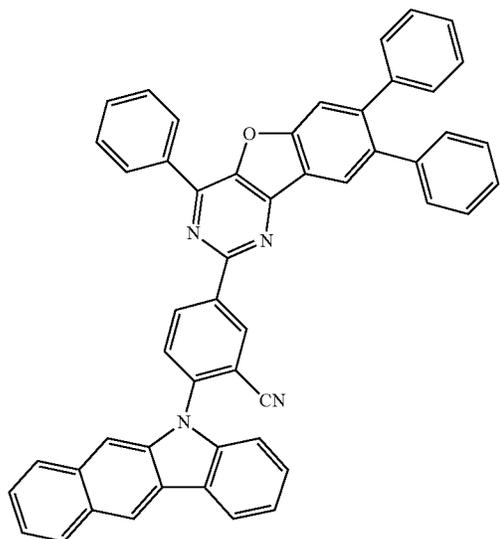
Chemical Formula a (10.0 g, 1.0 eq.), 3-chloro-9,9-dimethyl-2-(9-phenyl-9H-carbazol-4-yl)-9H-indeno[1,2-b]pyrazine (23.89 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 636 (20.73 g, yield 69%).  $[M+H]=653$

## SYNTHESIS EXAMPLE 69



421

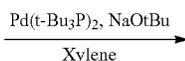
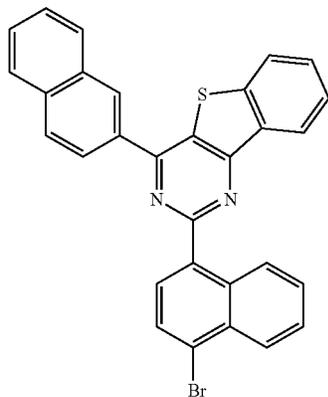
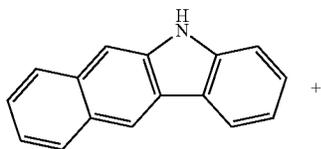
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697

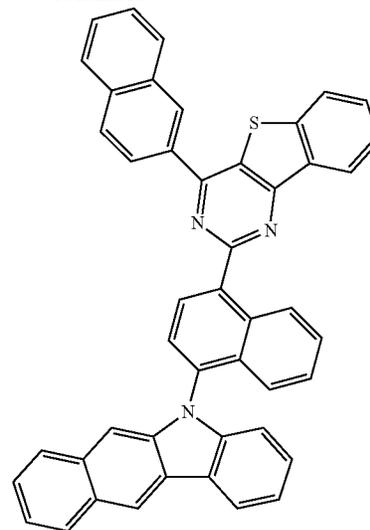
Chemical Formula a (10.0 g, 1.0 eq.), 2-bromo-5-(4,7,8-triphenylbenzofuro[3,2-d]pyrimidin-2-yl)benzonitrile (29.28 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 697 (21.38 g, yield 65%). [M+H]=715

## SYNTHESIS EXAMPLE 70



422

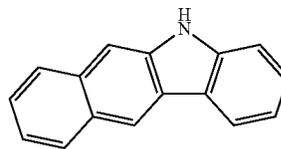
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701

Chemical Formula a (10.0 g, 1.0 eq.), 2-(4-bromonaphthalen-1-yl)-4-(naphthalen-2-yl)benzo[4,5]thieno[3,2-d]pyrimidine (26.19 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 701 (20.46 g, yield 68%). [M+H]=654

## SYNTHESIS EXAMPLE 71

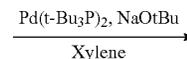
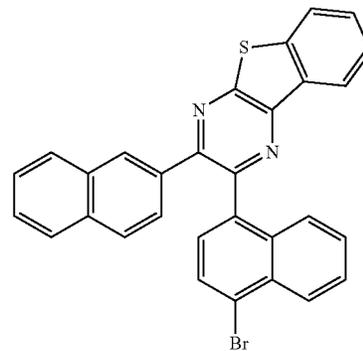


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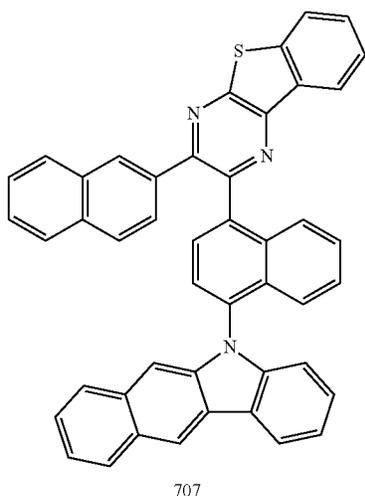
60

65



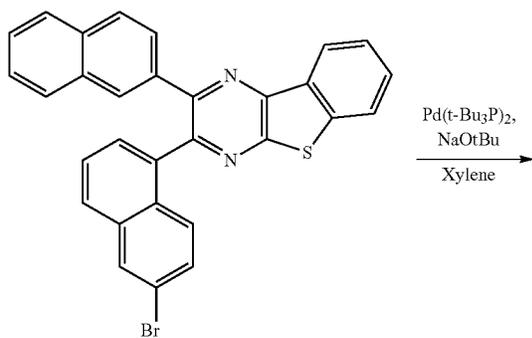
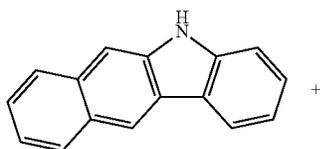
423

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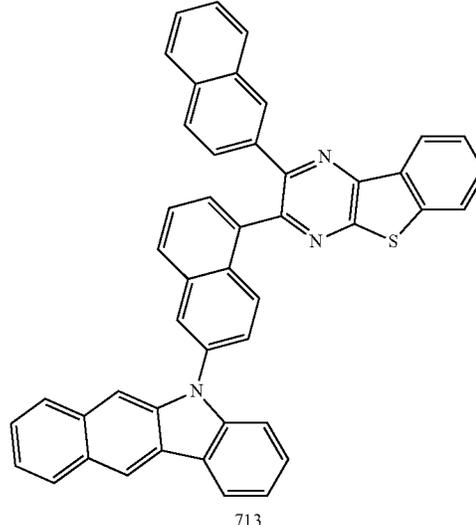
Chemical Formula a (10.0 g, 1.0 eq.), 2-(4-bromonaphthalen-1-yl)-3-(naphthalen-2-yl)benzo[4,5]thieno[2,3-b]pyrazine (26.19 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(*t*-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 707 (21.36 g, yield 71%). [M+H]=654

## SYNTHESIS EXAMPLE 72



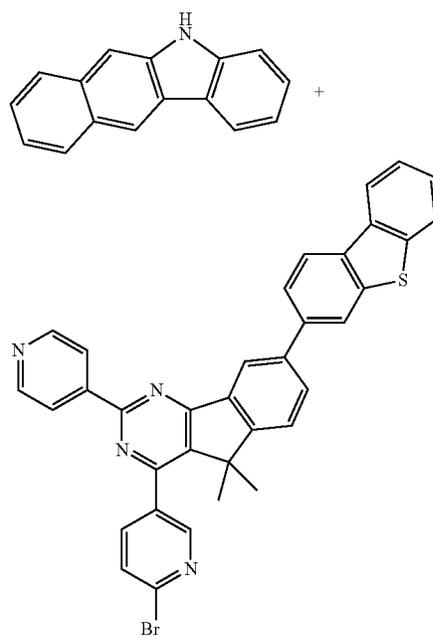
424

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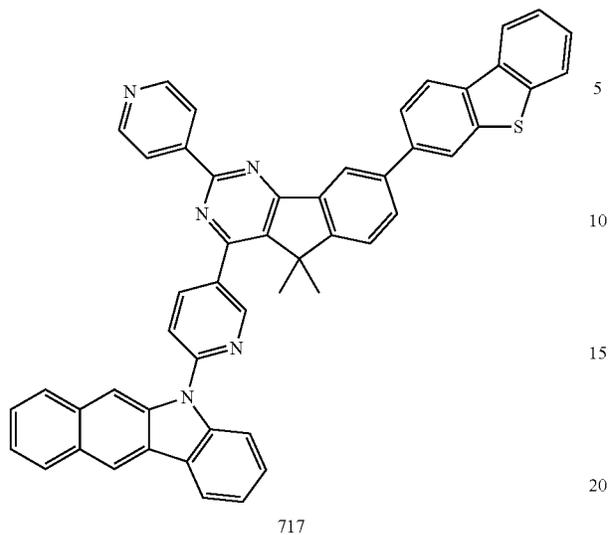
Chemical Formula a (10.0 g, 1.0 eq.), 3-(6-bromonaphthalen-1-yl)-2-(naphthalen-2-yl)benzo[4,5]thieno[2,3-b]pyrazine (26.19 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(*t*-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 713 (20.76 g, yield 69%). [M+H]=654

## SYNTHESIS EXAMPLE 73



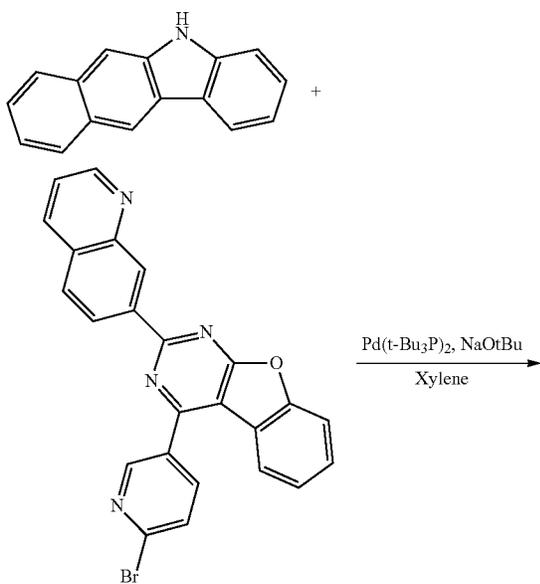
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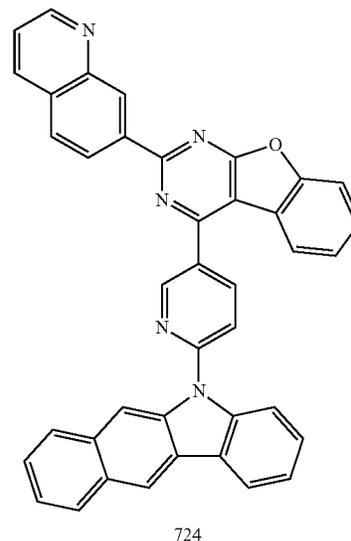
Chemical Formula a (10.0 g, 1.0 eq.), 4-(6-bromopyridin-3-yl)-8-(dibenzo[b,d]thiophen-3-yl)-5,5-dimethyl-2-(pyridin-4-yl)-5H-indeno[1,2-d]pyrimidine (30.96 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 717 (24.78 g, yield 72%). [M+H]=745

## SYNTHESIS EXAMPLE 74



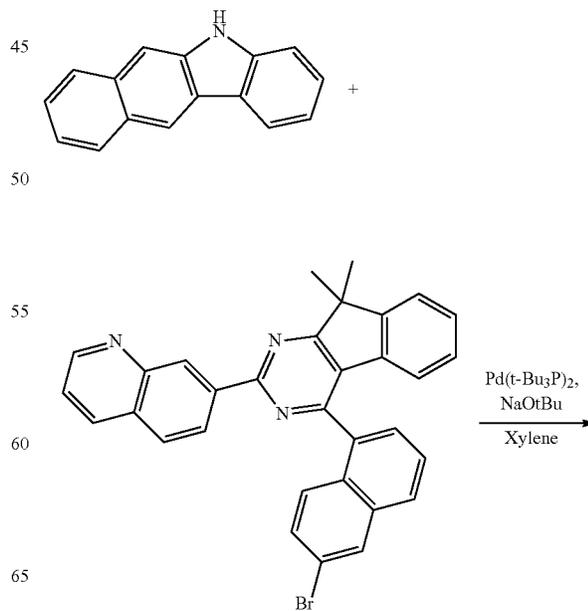
426

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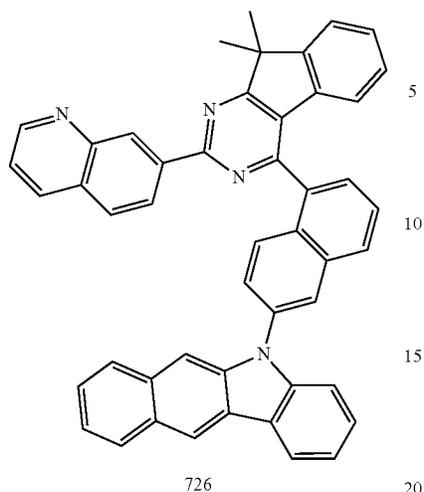
Chemical Formula a (10.0 g, 1.0 eq.), 4-(6-bromopyridin-3-yl)-2-(quinolin-7-yl)benzofuro[2,3-d]pyrimidine (22.94 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 724 (19.54 g, yield 72%). [M+H]=590

## SYNTHESIS EXAMPLE 75



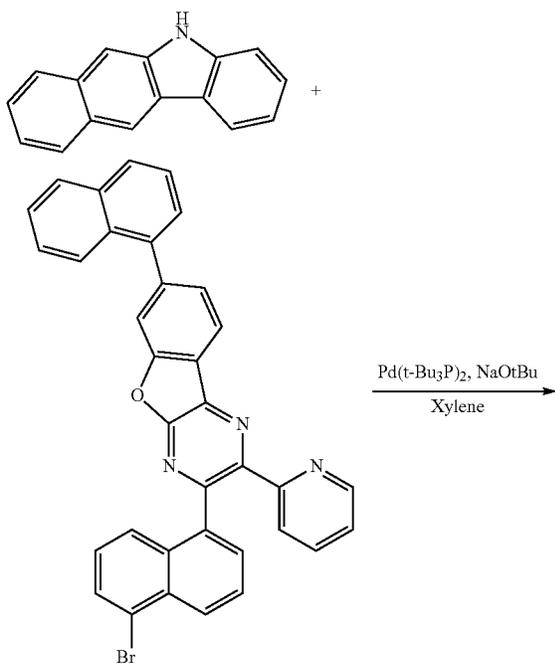
427

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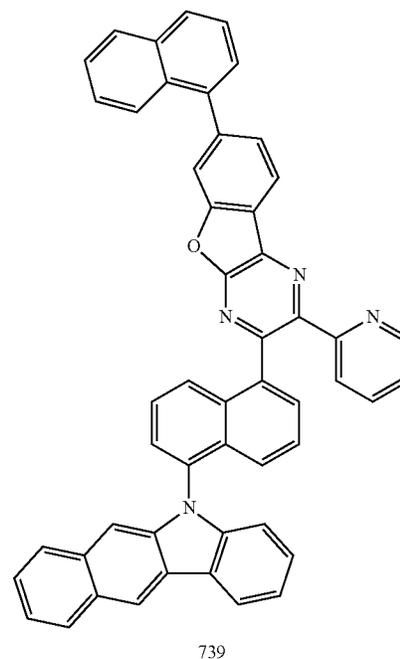
Chemical Formula a (10.0 g, 1.0 eq.), 4-(6-bromophthalen-1-yl)-9,9-dimethyl-2-(quinolin-7-yl)-9H-indeno[2,1-d]pyrimidine (26.75 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 726 (21.41 g, yield 70%). [M+H]<sup>+</sup>=665

## SYNTHESIS EXAMPLE 76



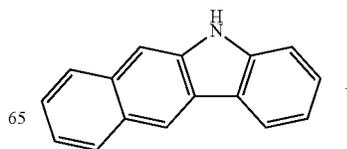
428

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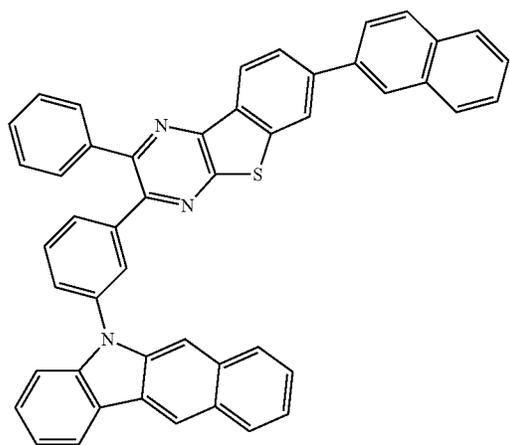
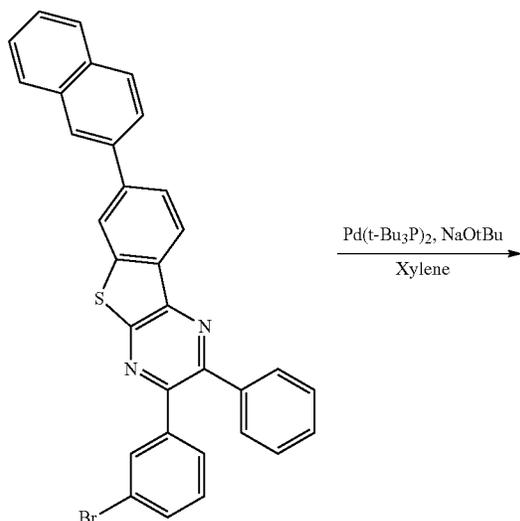
Chemical Formula a (10.0 g, 1.0 eq.), 3-(5-bromophthalen-1-yl)-7-(naphthalen-1-yl)-2-(pyridin-2-yl)benzofuro[2,3-b]pyrazine (29.28 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 739 (23.68 g, yield 72%). [M+H]<sup>+</sup>=715

## SYNTHESIS EXAMPLE 77



429

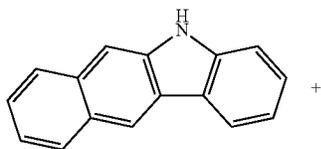
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740

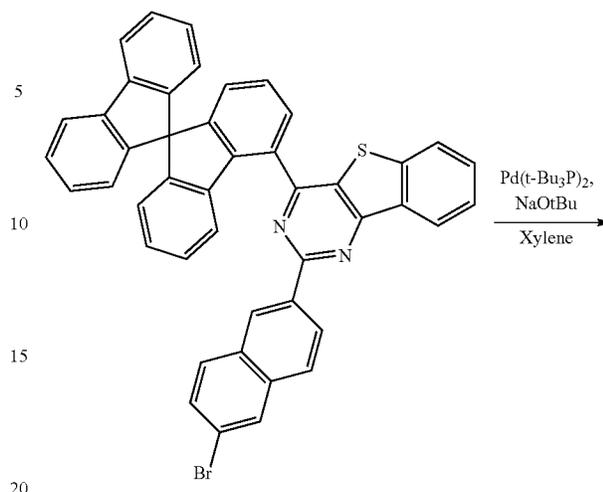
Chemical Formula a (10.0 g, 1.0 eq.), 3-(3-bromophenyl)-7-(naphthalen-2-yl)-2-phenylbenzo[4,5]thieno[2,3-b]pyridazine (27.51 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 740 (21.90 g, yield 70%). [M+H]=680

## SYNTHESIS EXAMPLE 78



430

-continued



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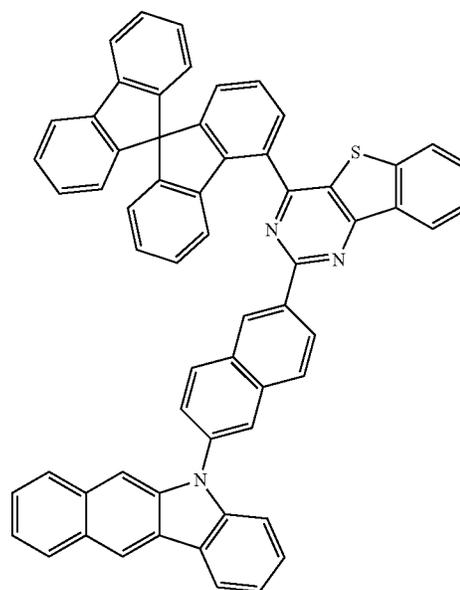
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65

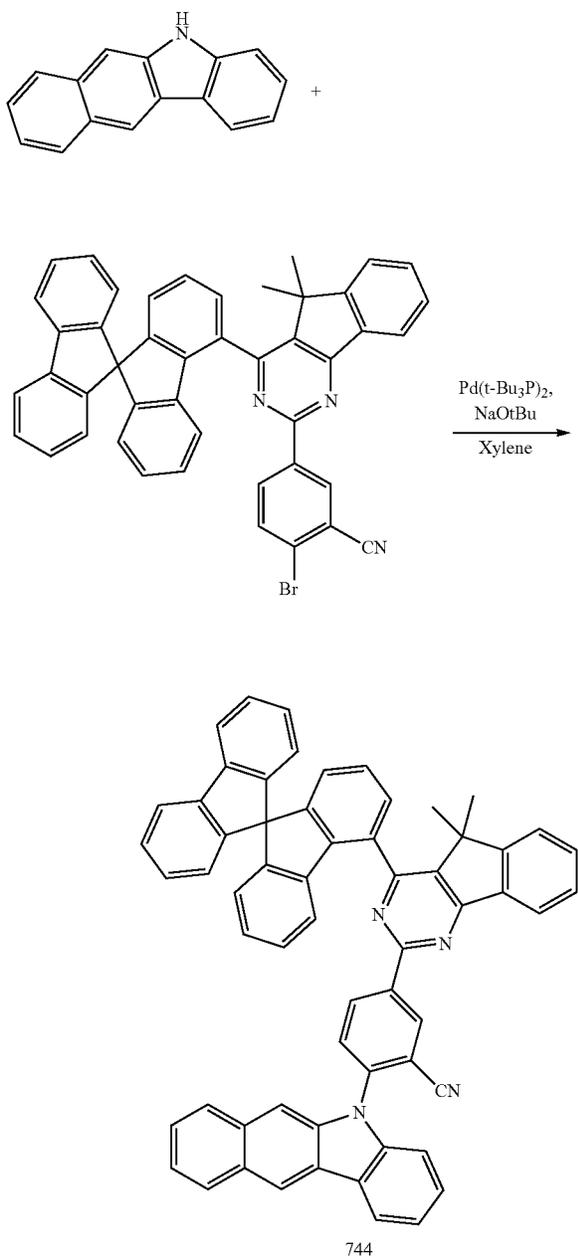


743

Chemical Formula a (10.0 g, 1.0 eq.), 4-(9'-spiro[fluoren]-4-yl)-2-(6-bromonaphthalen-2-yl)benzo[4,5]thieno[3,2-d]pyrimidine (35.72 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 743 (24.80 g, yield 64%). [M+H]=843

## 431

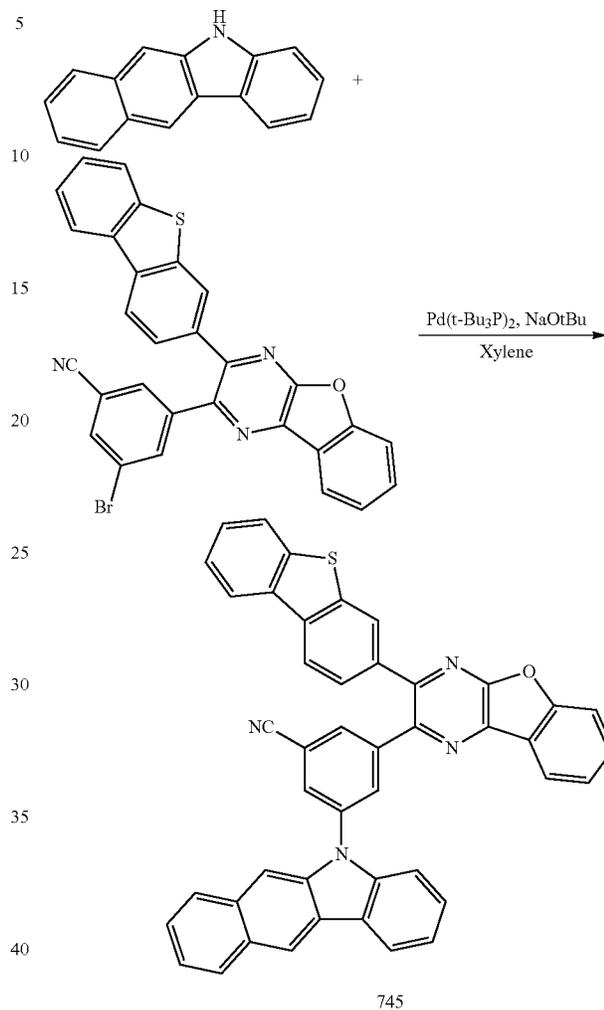
## SYNTHESIS EXAMPLE 79



Chemical Formula a (10.0 g, 1.0 eq.), 5-(4-(9,9'-spiro[fluoren]-4-yl)-5,5-dimethyl-5H-indeno[1,2-d]pyrimidin-2-yl)-2-bromobenzonitrile (34.96 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 744 (25.50 g, yield 67%). [M+H]=828

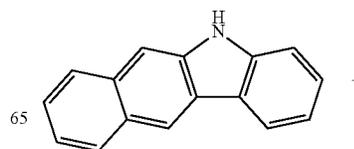
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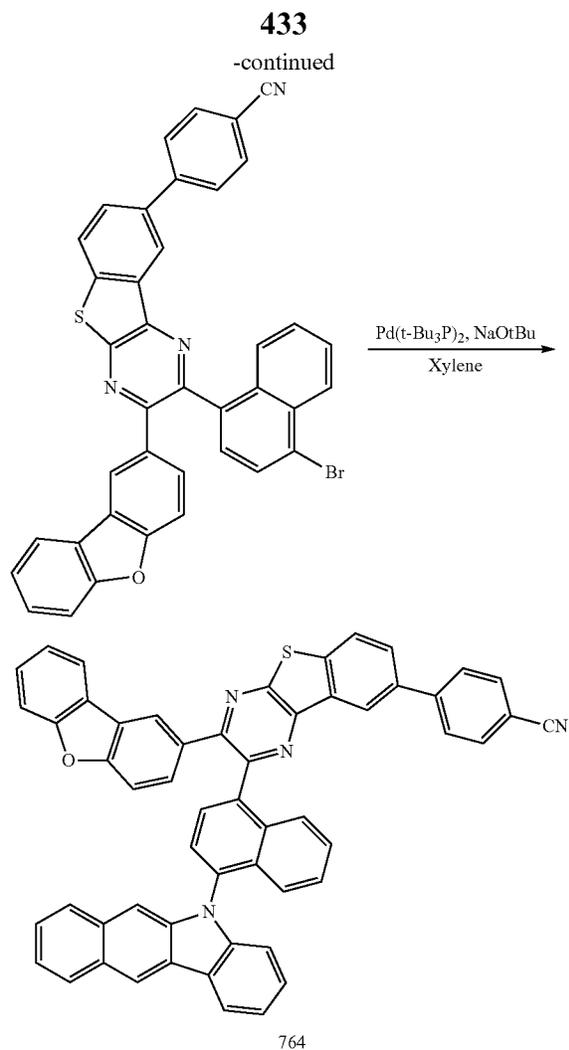
## SYNTHESIS EXAMPLE 80



Chemical Formula a (10.0 g, 1.0 eq.), 3-bromo-5-(3-(dibenzo[b,d]thiophen-3-yl)benzofuro[2,3-b]pyrazin-2-yl)benzonitrile (26.95 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 745 (19.69 g, yield 64%). [M+H]=669

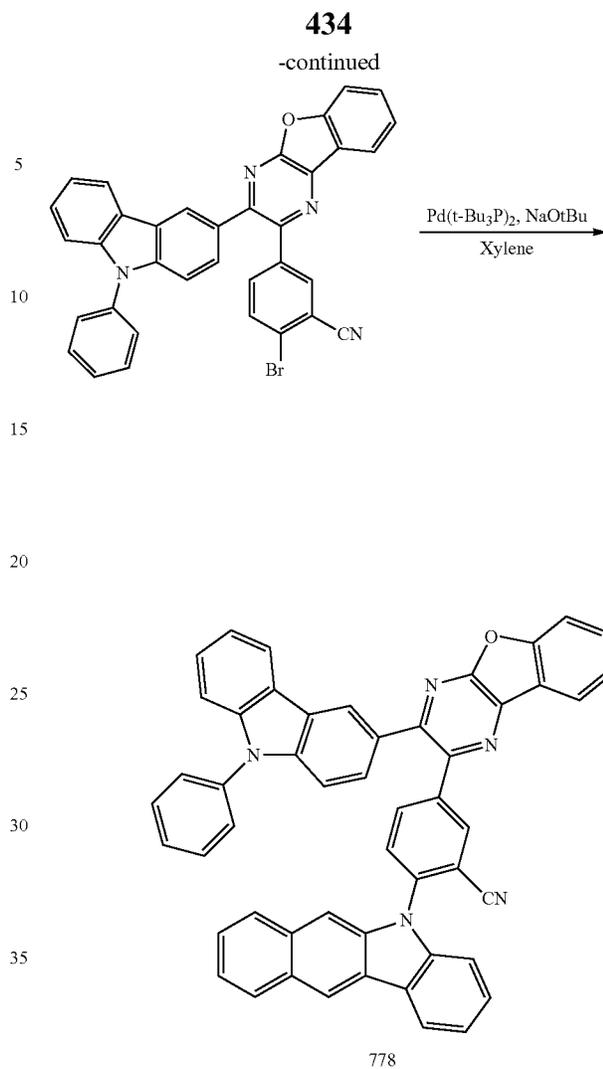
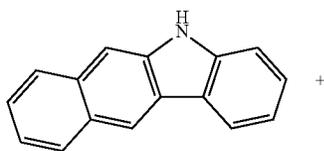
## SYNTHESIS EXAMPLE 81





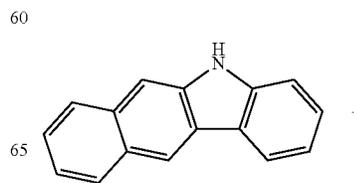
Chemical Formula a (10.0 g, 1.0 eq.), 4-(2-(4-bromonaphthalen-1-yl)-3-(dibenzo[b,d]furan-2-yl)benzo[4,5]thieno[2,3-b]pyrazin-8-yl)benzotrile (33.34 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(*t*-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 764 (22.31 g, yield 61%). [M+H]=795

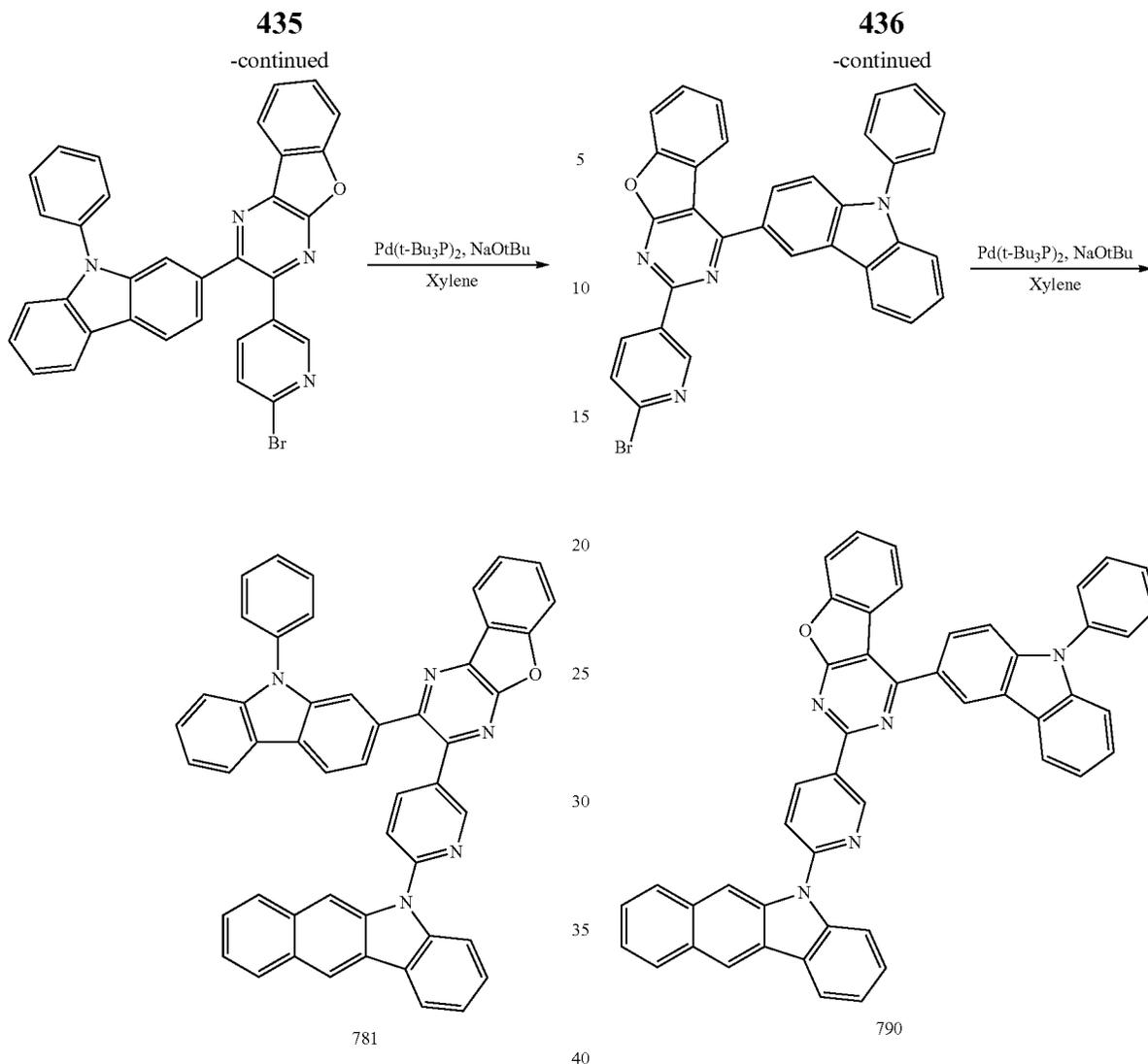
## SYNTHESIS EXAMPLE 82



Chemical Formula a (10.0 g, 1.0 eq.), 2-bromo-5-(3-(9-phenyl-9H-carbazol-3-yl)benzofuro[2,3-b]pyrazin-2-yl)benzotrile (29.94 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(*t*-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 778 (21.10 g, yield 63%). [M+H]=728

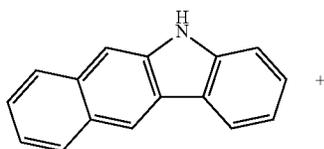
## SYNTHESIS EXAMPLE 83





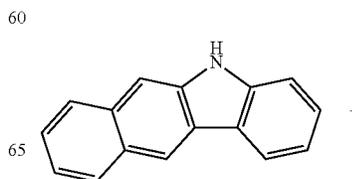
Chemical Formula a (10.0 g, 1.0 eq.), 3-(6-bromopyridin-3-yl)-2-(9-phenyl-9H-carbazol-2-yl)benzofuro[2,3-b]pyrazine (28.72 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 781 (20.73 g, yield 64%). [M+H]=704

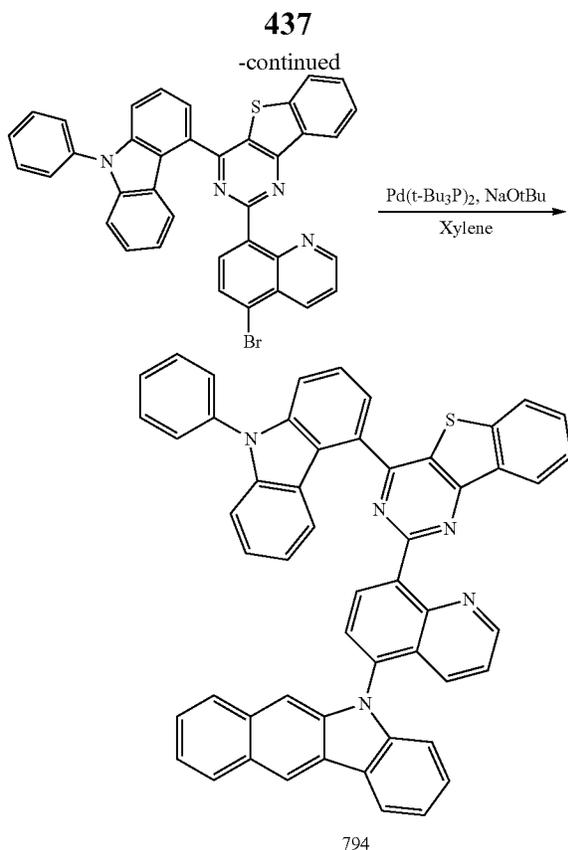
## SYNTHESIS EXAMPLE 84



Chemical Formula a (10.0 g, 1.0 eq.), 2-(6-bromopyridin-3-yl)-4-(9-phenyl-9H-carbazol-3-yl)benzofuro[2,3-d]pyrimidine (28.729 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 790 (21.70 g, yield 67%). [M+H]=704

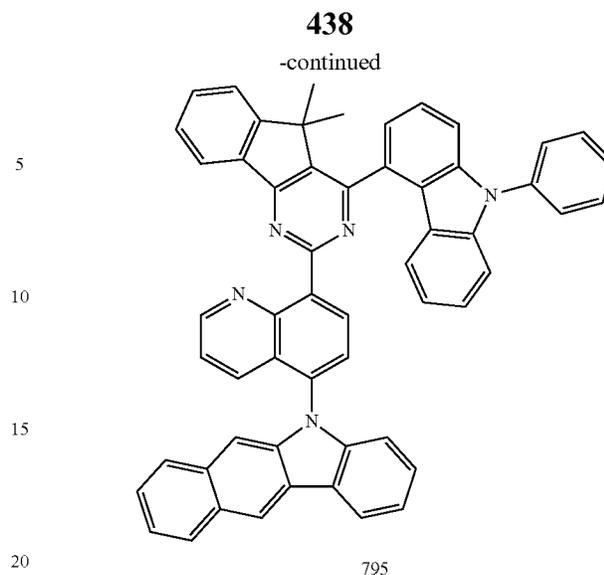
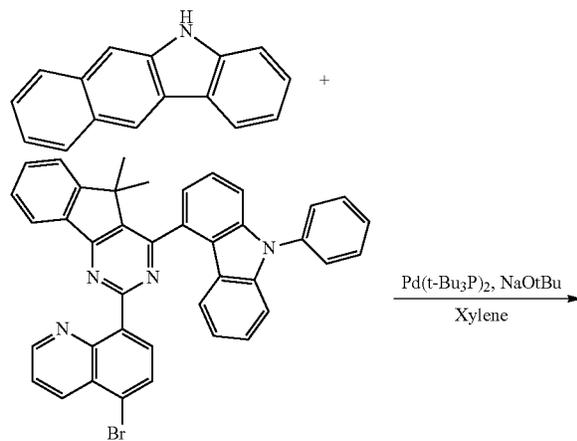
## SYNTHESIS EXAMPLE 85





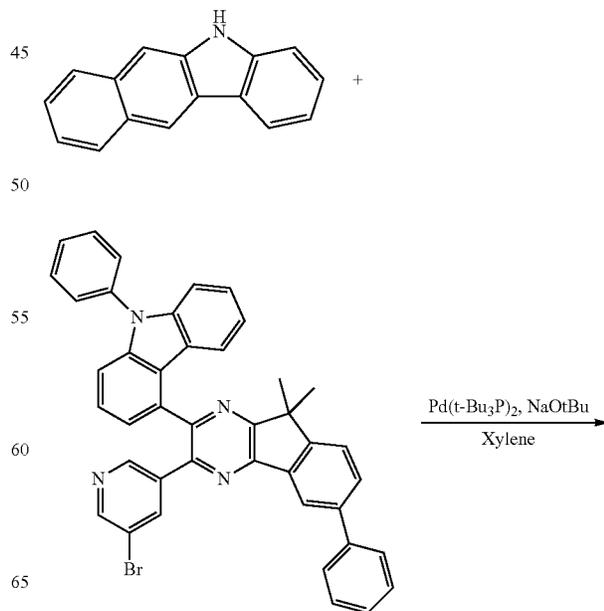
Chemical Formula a (10.0 g, 1.0 eq.), 2-(5-bromoquinolin-8-yl)-4-(9-phenyl-9H-carbazol-4-yl)benzo[4,5]thieno[3,2-d]pyrimidine (32.07 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 794 (23.03 g, yield 65%). [M+H]<sup>+</sup>=770

## SYNTHESIS EXAMPLE 86



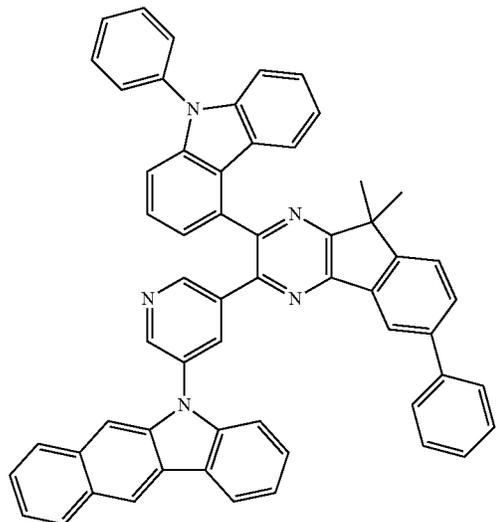
Chemical Formula a (10.0 g, 1.0 eq.), 2-(5-bromoquinolin-8-yl)-5,5-dimethyl-4-(9-phenyl-9H-carbazol-4-yl)-5H-indeno[1,2-d]pyrimidine (32.58 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 795 (23.33 g, yield 67%). [M+H]<sup>+</sup>=780

## SYNTHESIS EXAMPLE 87



439

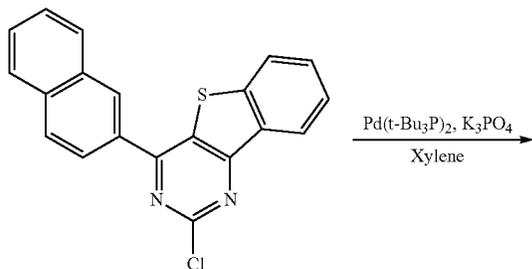
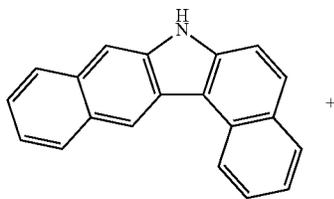
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798

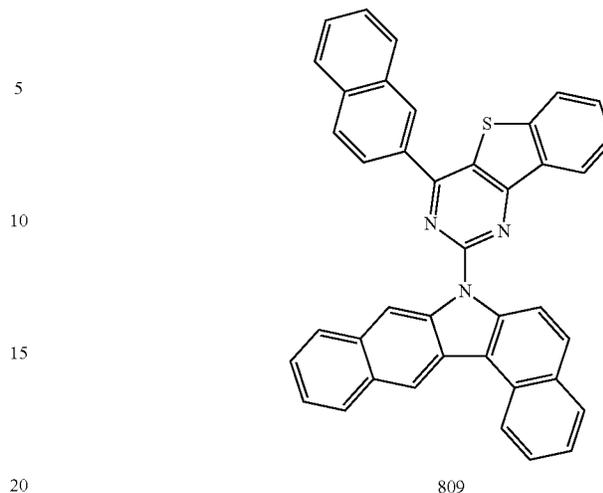
Chemical Formula a (10.0 g, 1.0 eq.), 3-(5-bromopyridin-3-yl)-9,9-dimethyl-6-phenyl-2-(9-phenyl-9H-carbazol-4-yl)-9H-indeno[1,2-b]pyrazine (33.90 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 798 (24.85 g, yield 67%). [M+H]=806

## SYNTHESIS EXAMPLE 88



440

-continued

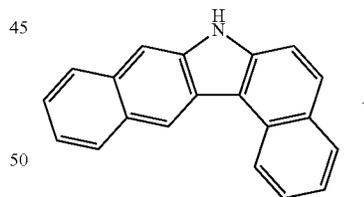


809

Chemical Formula d (10.0 g, 1.0 eq.), 2-chloro-4-(naphthalen-2-yl)benzo[4,5]thieno[3,2-d]pyrimidine (17.55 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 809 (18.34 g, yield 69%). [M+H]=578

FIG. 9 is a graph showing an 1H-NMR value of Chemical Formula 809.

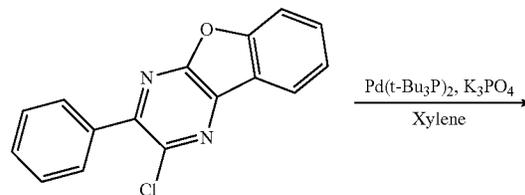
## SYNTHESIS EXAMPLE 89



55

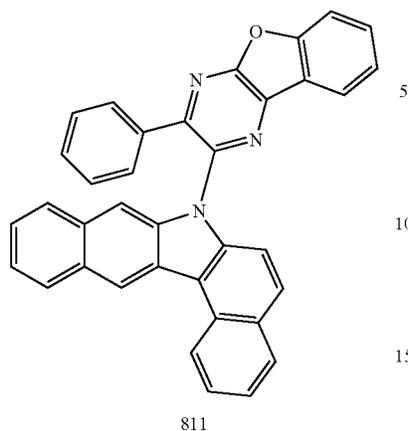
60

65



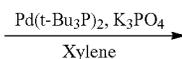
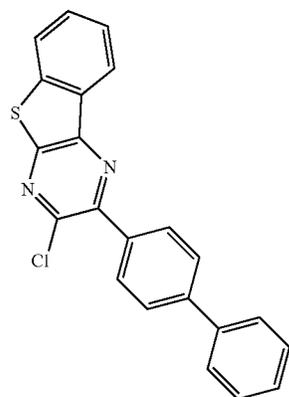
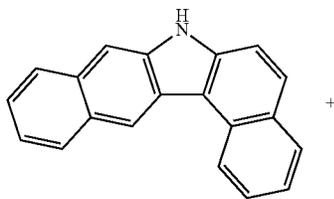
441

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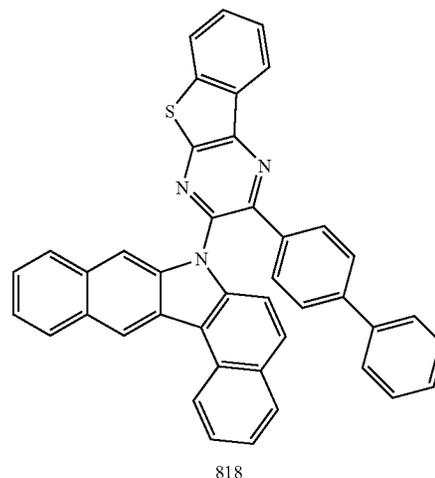
Chemical Formula d (10.0 g, 1.0 eq.), 2-chloro-3-phenylbenzofuro[2,3-b]pyrazine (17.25 g, 1.1 eq.),  $K_3PO_4$  (14.21 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 811 (15.06 g, yield 64%).  $[M+H]=512$

## SYNTHESIS EXAMPLE 90



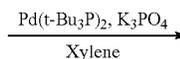
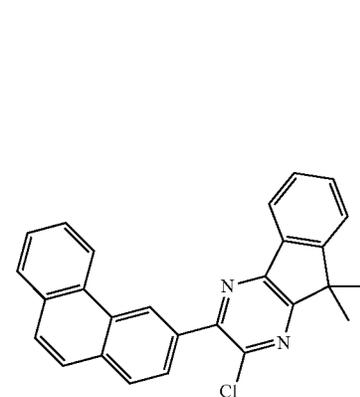
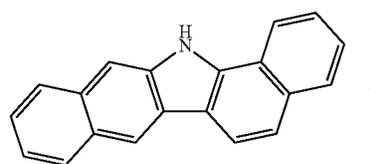
442

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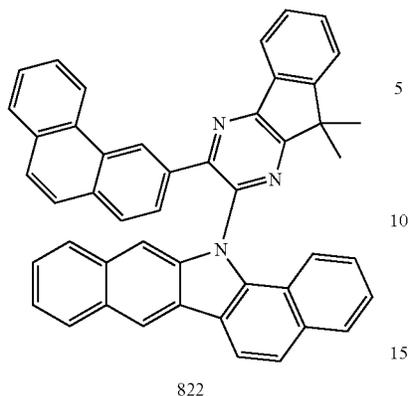
Chemical Formula d (10.0 g, 1.0 eq.), 2-([1,1'-biphenyl]-4-yl)-3-chlorobenzo[4,5]thieno[2,3-b]pyrazine (18.87 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 818 (18.61 g, yield 67%).  $[M+H]=604$

## SYNTHESIS EXAMPLE 91



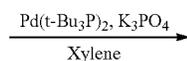
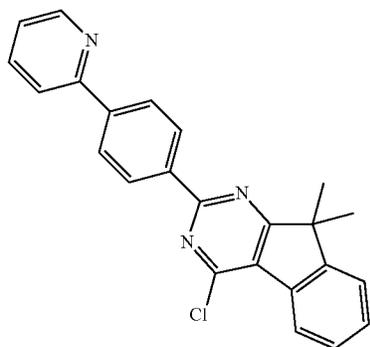
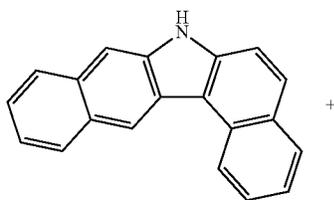
443

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Chemical Formula b (10.0 g, 1.0 eq.), 2-chloro-9,9-dimethyl-3-(phenanthren-3-yl)-9H-indeno[1,2-b]pyridine (20.60 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 822 (19.08 g, yield 65%).  $[M+H]=638$

## SYNTHESIS EXAMPLE 92



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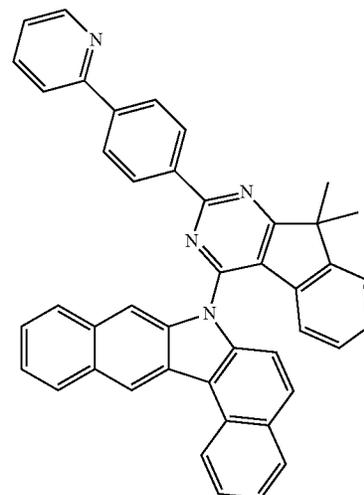
55

60

65

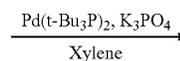
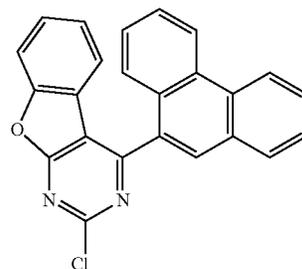
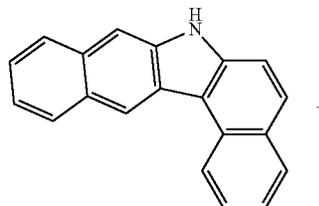
444

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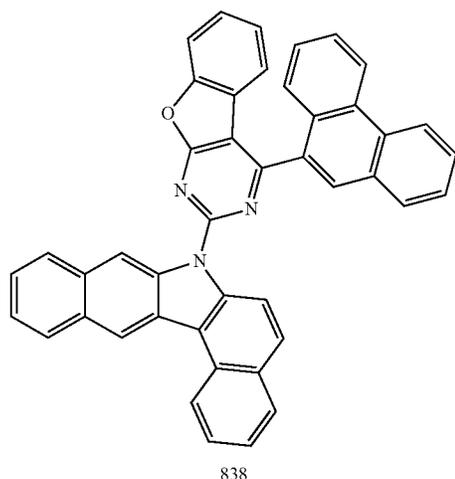
Chemical Formula d (10.0 g, 1.0 eq.), 4-chloro-9,9-dimethyl-2-(4-(pyridin-2-yl)phenyl)-9H-indeno[2,1-d]pyrimidine (19.43 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 831 (19.24 g, yield 68%).  $[M+H]=615$

## SYNTHESIS EXAMPLE 93



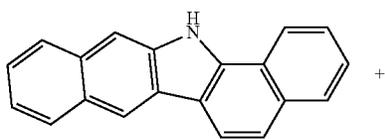
445

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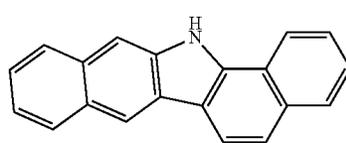


Chemical Formula d (10.0 g, 1.0 eq.), 2-chloro-4-(phenanthren-9-yl)benzofuro[2,3-d]pyrimidine (19.28 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 838 (18.30 g, yield 65%).  $[M+H]=612$

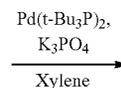
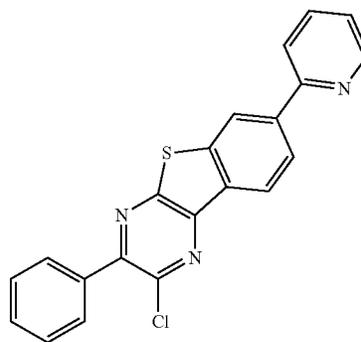
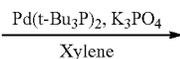
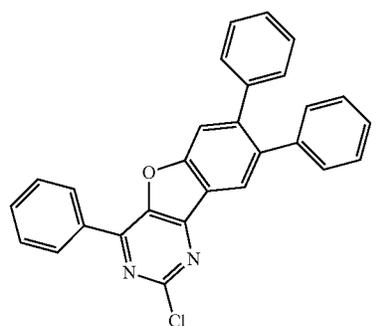
## SYNTHESIS EXAMPLE 94



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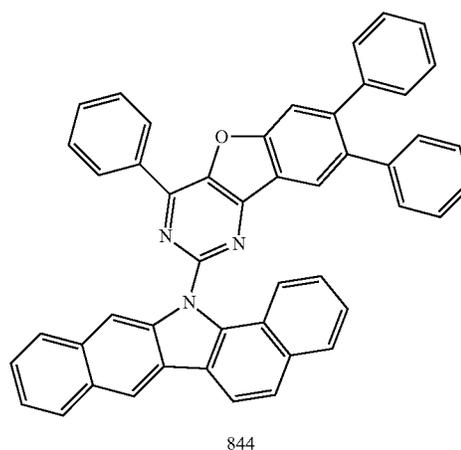


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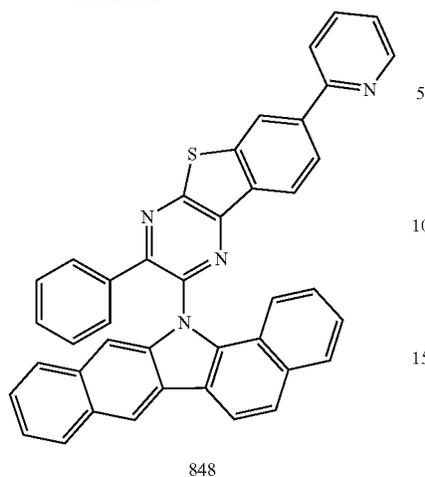


Chemical Formula b (10.0 g, 1.0 eq.), 2-chloro-4,7,8-triphenylbenzofuro[3,2-d]pyrimidine (21.91 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 844 (20.46 g, yield 67%).  $[M+H]=664$

## SYNTHESIS EXAMPLE 95

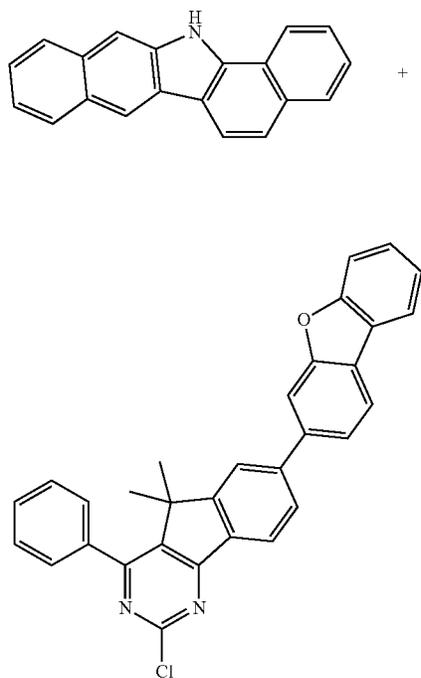
447

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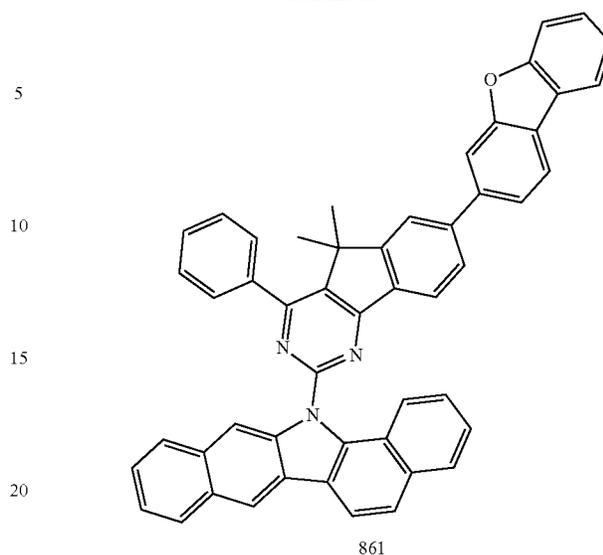
Chemical Formula b (10.0 g, 1.0 eq.), 2-chloro-3-phenyl-7-(pyridin-2-yl)benzo[4,5]thieno[2,3-b]pyrazine (18.92 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 848 (18.09 g, yield 65%).  $[M+H]=605$

## SYNTHESIS EXAMPLE 96



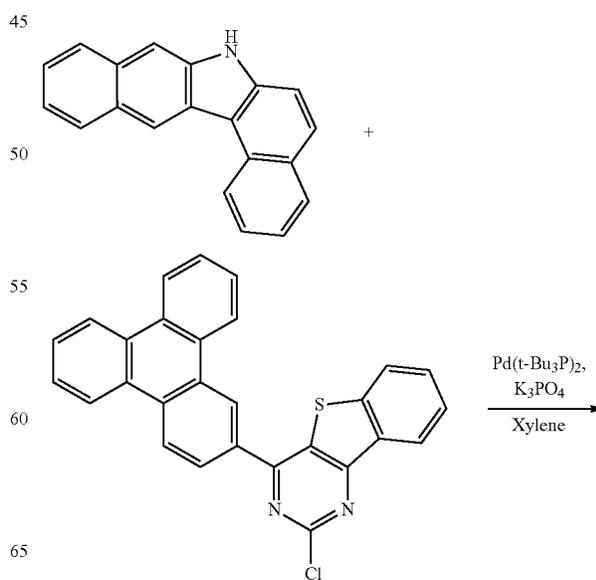
448

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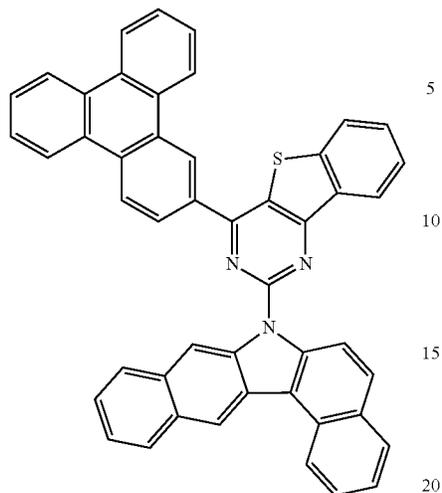
Chemical Formula b (10.0 g, 1.0 eq.), 2-chloro-7-(dibenzo[b,d]furan-3-yl)-5,5-dimethyl-4-phenyl-5H-indeno[1,2-d]pyrimidine (23.94 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 861 (21.38 g, yield 66%).  $[M+H]=704$

## SYNTHESIS EXAMPLE 97



449

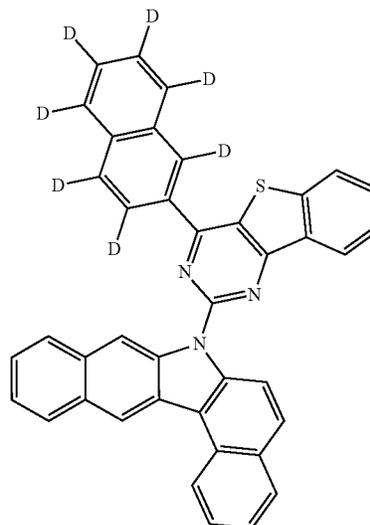
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863

450

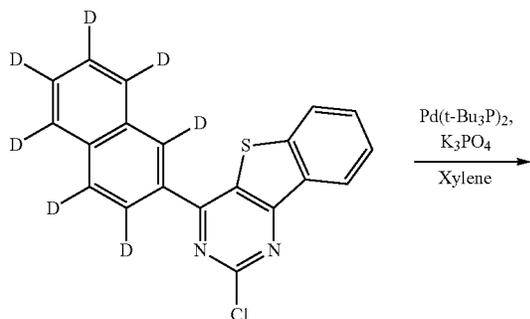
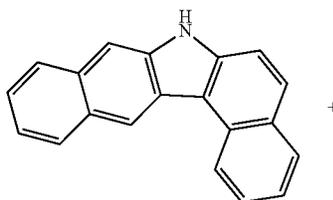
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866

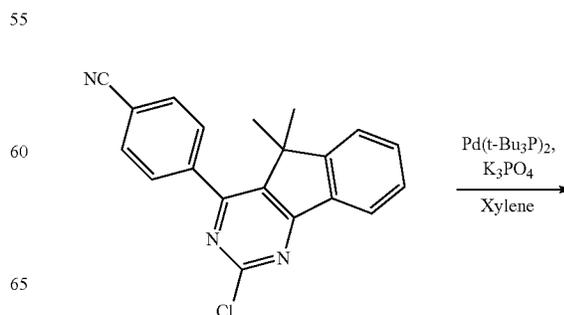
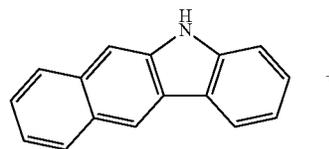
Chemical Formula d (10.0 g, 1.0 eq.), 2-chloro-4-(triphenyl-<sup>2</sup>H<sub>7</sub>)benzo[4,5]thieno[3,2-d]pyrimidine (22.62 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 863 (19.96 g, yield 64%). [M+H]<sup>+</sup>=678

## SYNTHESIS EXAMPLE 98



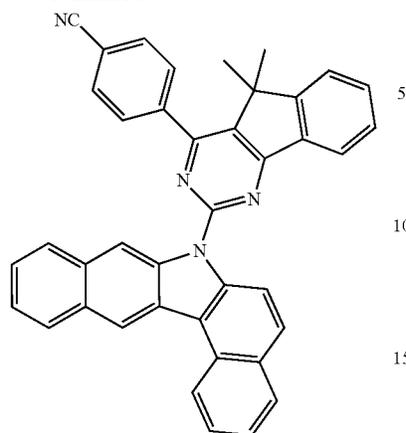
Chemical Formula d (10.0 g, 1.0 eq.), 2-chloro-4-(naphthalen-2-yl-d<sub>7</sub>)benzo[4,5]thieno[3,2-d]pyrimidine (17.91 g, 1.1 eq.), K<sub>3</sub>PO<sub>4</sub> (19.53 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 866 (16.14 g, yield 60%). [M+H]<sup>+</sup>=585

## SYNTHESIS EXAMPLE 99



451

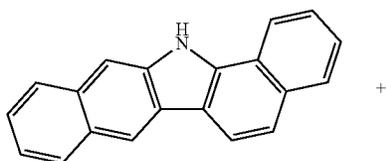
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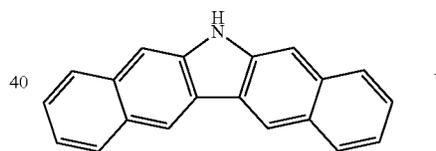
867

Chemical Formula d (10.0 g, 1.0 eq.), 4-(2-chloro-5,5-dimethyl-5H-indeno[1,2-d]pyrimidin-4-yl)benzonitrile (16.79 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 867 (17.35 g, yield 67%).  $[M+H]=563$

## SYNTHESIS EXAMPLE 100



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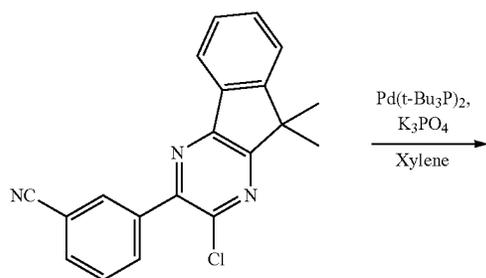
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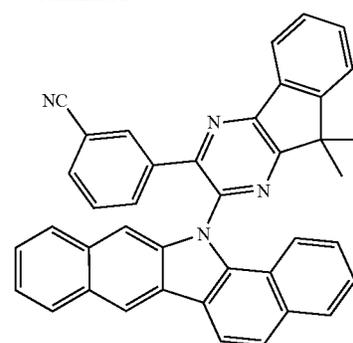
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452

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869

Chemical Formula b (10.0 g, 1.0 eq.), 3-(2-chloro-9,9-dimethyl-9H-indeno[1,2-b]pyridin-3-yl)benzonitrile (16.79 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 869 (16.57 g, yield 64%).  $[M+H]=563$

## SYNTHESIS EXAMPLE 101

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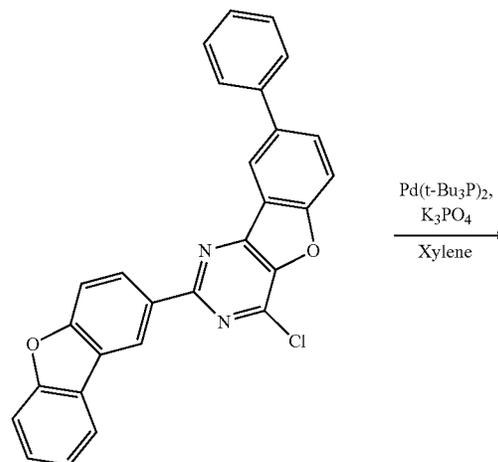
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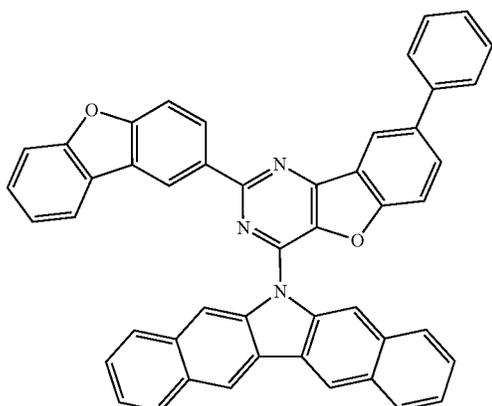
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453

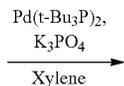
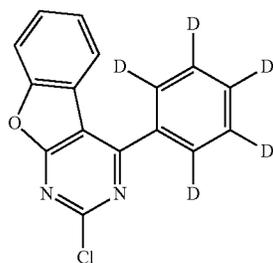
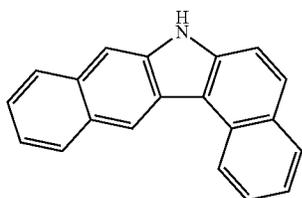
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870

Chemical Formula c (10.0 g, 1.0 eq.), 4-chloro-2-(dibenzo[b,d]furan-2-yl)-8-phenylbenzofuro[3,2-d]pyrimidine (22.62 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 870 (20.90 g, yield 67%).  $[M+H]=678$

## SYNTHESIS EXAMPLE 102



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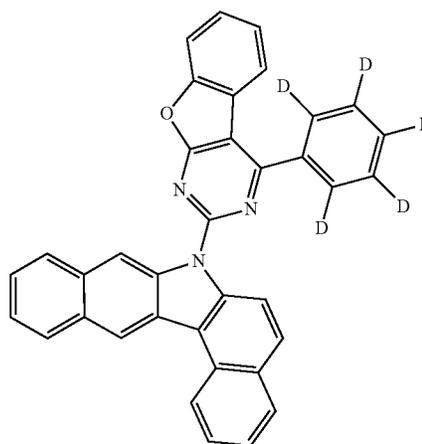
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871

Chemical Formula d (10.0 g, 1.0 eq.), 2-chloro-4-(phenyl-d5)benzofuro[2,3-d]pyrimidine (14.46 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 871 (17.83 g, yield 75%).  $[M+H]=517$

## SYNTHESIS EXAMPLE 103

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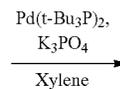
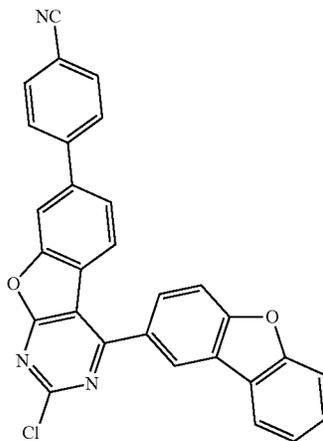
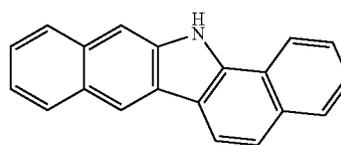
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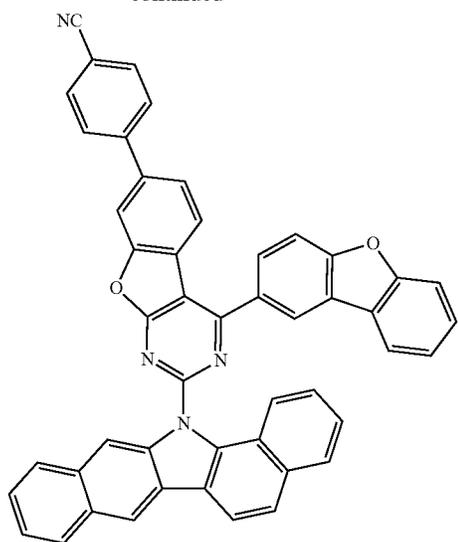
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455

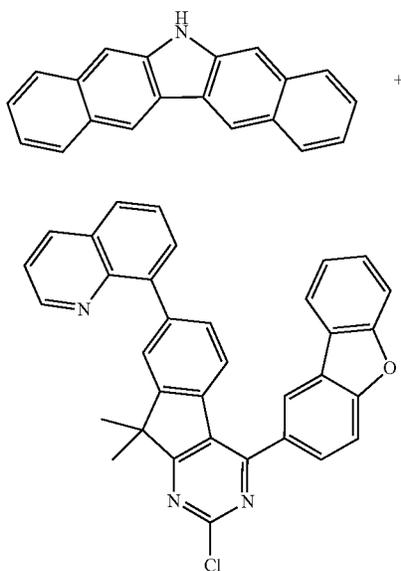
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874

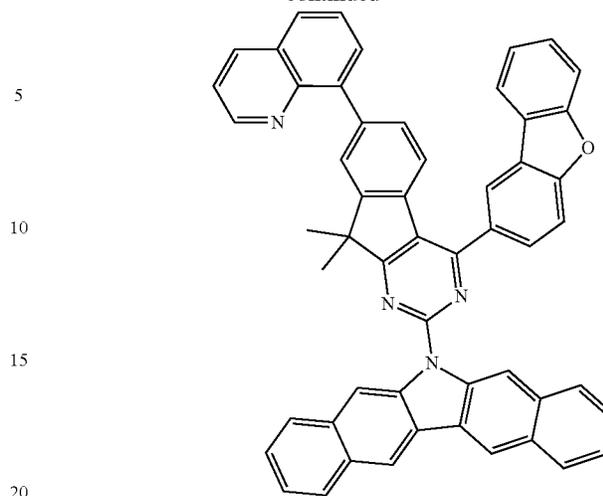
Chemical Formula b (10.0 g, 1.0 eq.), 4-(2-chloro-4-(dibenzo[b,d]furan-2-yl)benzofuro[2,3-d]pyrimidin-7-yl) benzonitrile (23.89 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 874 (21.67 g, yield 67%).  $[M+H]=703$

## SYNTHESIS EXAMPLE 104



456

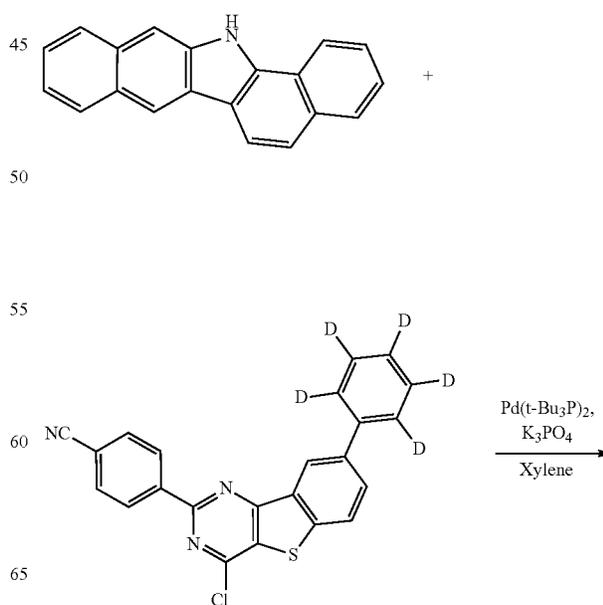
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876

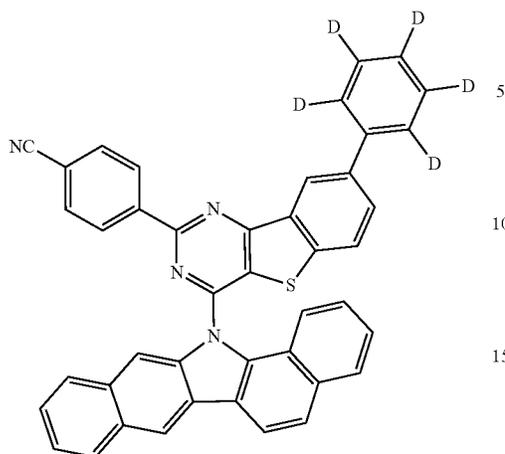
Chemical Formula c (10.0 g, 1.0 eq.), 2-chloro-4-(dibenzo [b,d]furan-2-yl)-9,9-dimethyl-7-(quinolin-8-yl)-9H-indeno [2,1-d]pyrimidine (26.53 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 876 (22.58 g, yield 65%).  $[M+H]=634$

## SYNTHESIS EXAMPLE 105



457

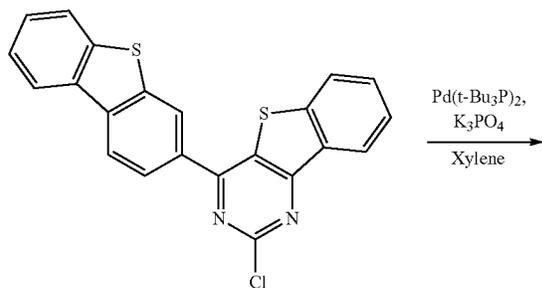
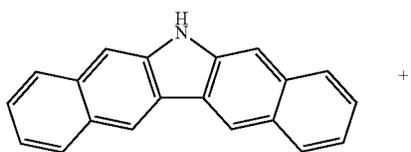
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878

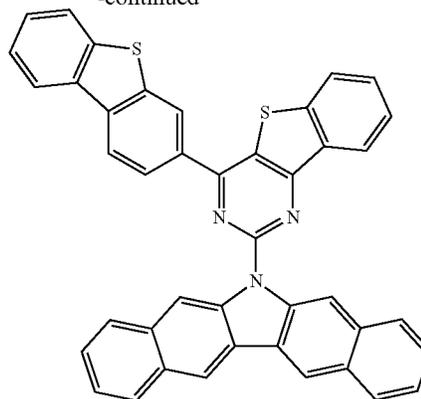
Chemical Formula b (10.0 g, 1.0 eq.), 4-(4-chloro-8-(phenyl-d5)benzo[4,5]thieno[3,2-d]pyrimidin-2-yl)benzotrile (20.39 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 878 (18.96 g, yield 65%).  $[M+H]=634$

## SYNTHESIS EXAMPLE 106



458

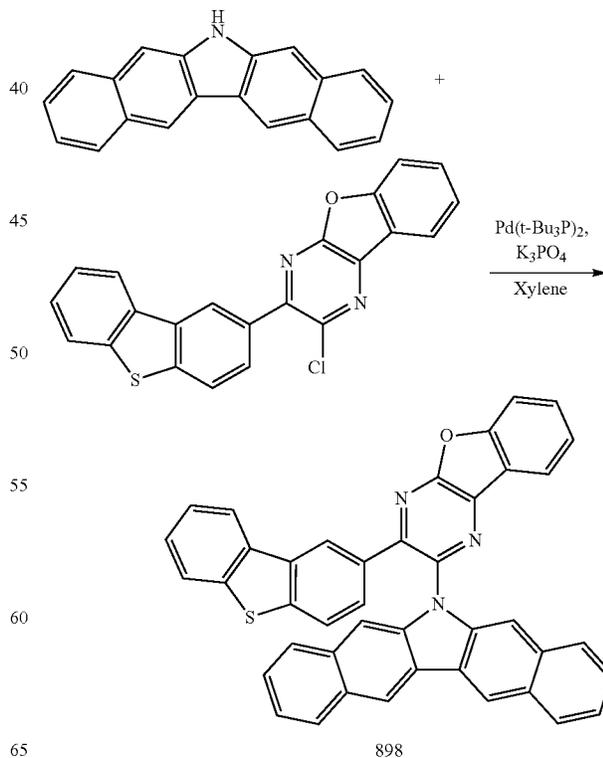
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890

Chemical Formula c (10.0 g, 1.0 eq.), 2-chloro-4-(dibenzo[b,d]thiophen-3-yl)benzo[4,5]thieno[3,2-d]pyrimidine (20.39 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 890 (18.08 g, yield 62%).  $[M+H]=634$

## SYNTHESIS EXAMPLE 107

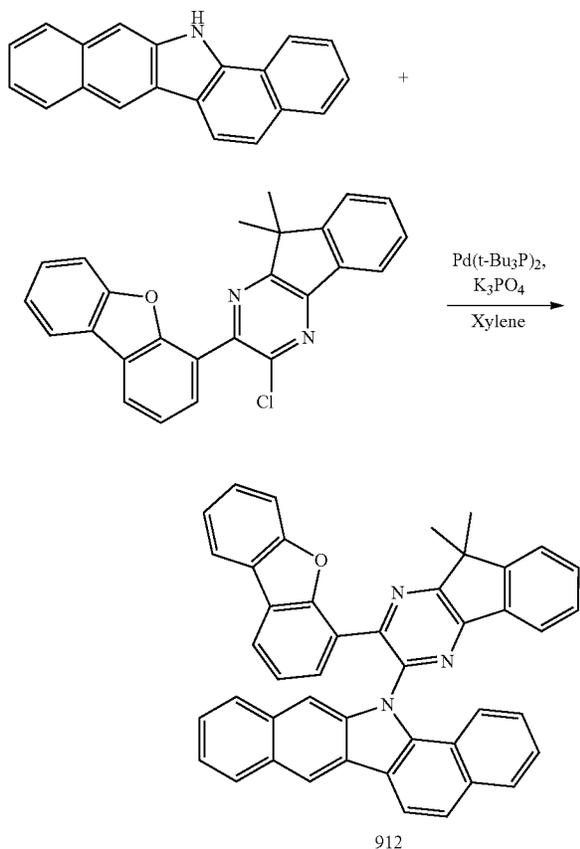


898

## 459

Chemical Formula c (10.0 g, 1.0 eq.), 2-chloro-3-(dibenzo[b,d]thiophen-2-yl)benzofuro[2,3-b]pyrazine (19.58 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 898 (18.19 g, yield 64%).  $[M+H]^+=618$

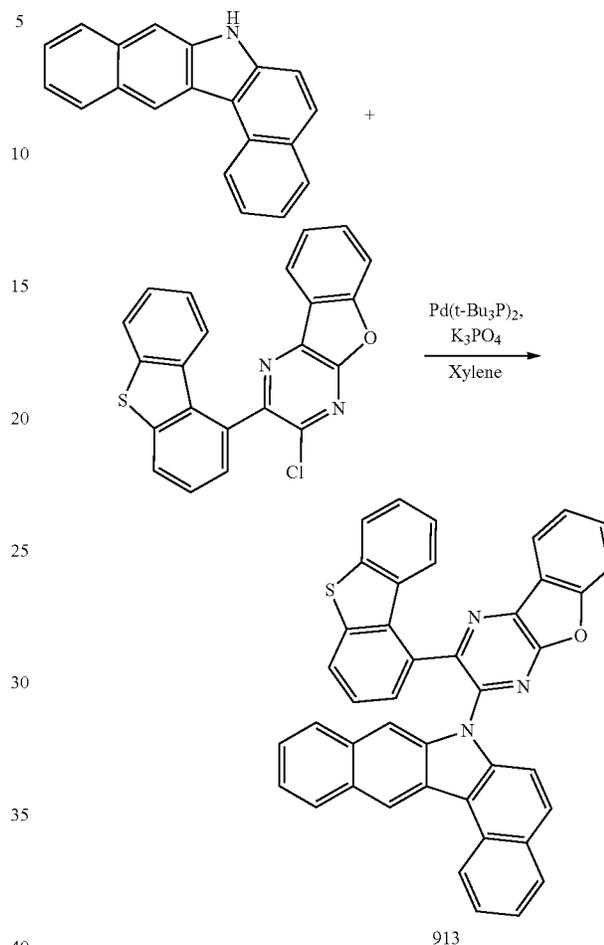
## SYNTHESIS EXAMPLE 108



Chemical Formula b (10.0 g, 1.0 eq.), 3-chloro-2-(dibenzo[b,d]furan-4-yl)-9,9-dimethyl-9H-indeno[1,2-b]pyrazine (20.09 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 912 (19.35 g, yield 67%).  $[M+H]^+=628$

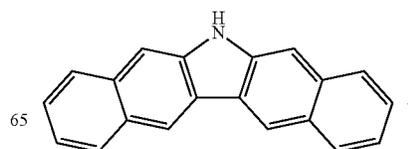
## 460

## SYNTHESIS EXAMPLE 109



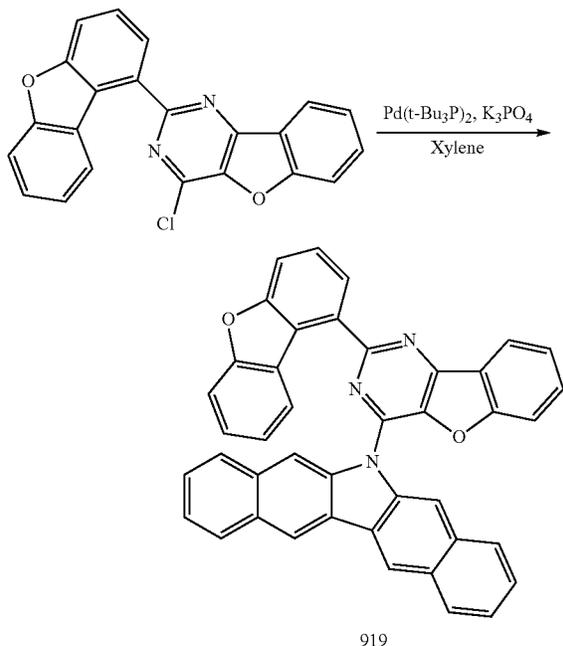
Chemical Formula d (10.0 g, 1.0 eq.), 3-chloro-2-(dibenzo[b,d]thiophen-1-yl)benzofuro[2,3-b]pyrazine (19.58 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 913 (20.18 g, yield 71%).  $[M+H]^+=618$

## SYNTHESIS EXAMPLE 110



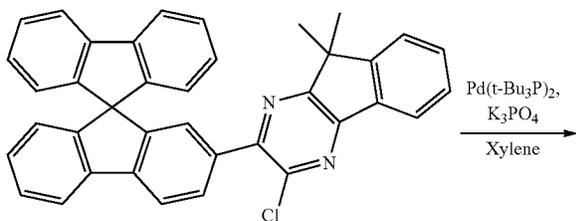
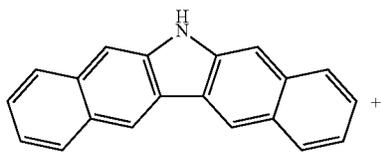
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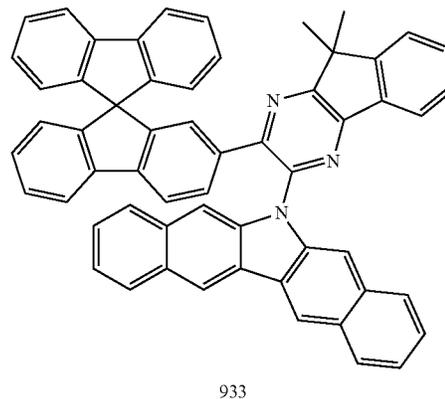
Chemical Formula c (10.0 g, 1.0 eq.), 4-chloro-2-(dibenzo [b,d]furan-1-yl)benzofuro[3,2-d]pyrimidine (18.77 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 919 (19.38 g, yield 70%).  $[M+H]=602$

## SYNTHESIS EXAMPLE 111



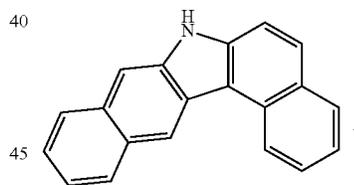
462

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Chemical Formula c (10.0 g, 1.0 eq.), 2-(9,9'-spirobi [fluoren]-2-yl)-3-chloro-9,9-dimethyl-9H-indeno[1,2-b] pyrazine (27.59 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 933 (23.92 g, yield 67%).  $[M+H]=776$

## SYNTHESIS EXAMPLE 112

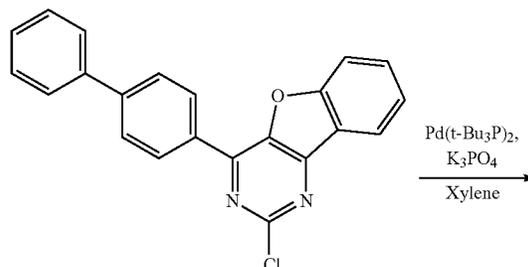


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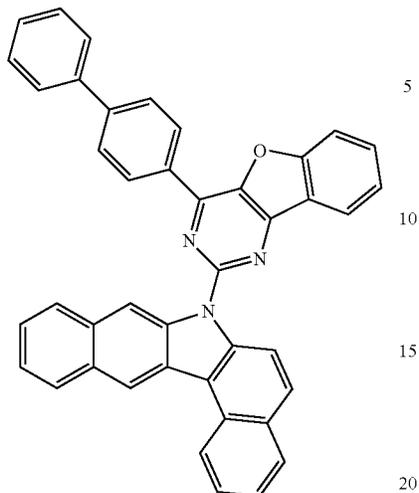
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463

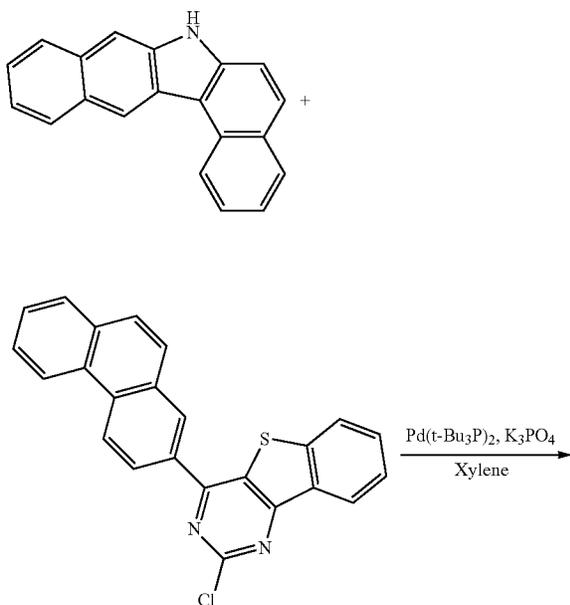
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937

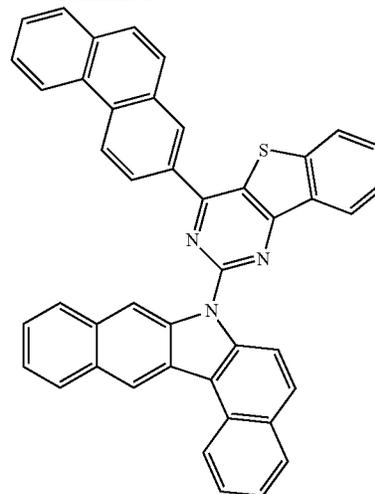
Chemical Formula d (10.0 g, 1.0 eq.), 4-([1,1'-biphenyl]-4-yl)-2-chlorobenzofuro[3,2-d]pyrimidine (18.06 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 937 (19.47 g, yield 72%).  $[M+H]=588$

## SYNTHESIS EXAMPLE 113



464

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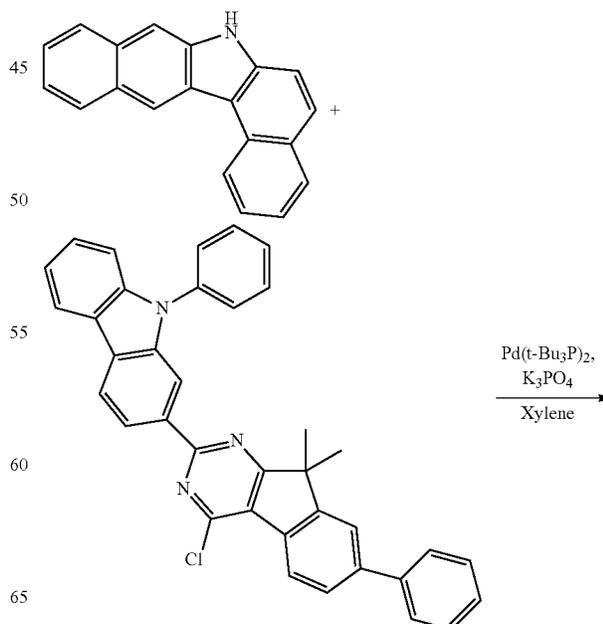


941

Chemical Formula d (10.0 g, 1.0 eq.), 2-chloro-4-(phenanthren-2-yl)benzo[4,5]thieno[3,2-d]pyrimidine (20.09 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 941 (21.38 g, yield 74%).  $[M+H]=628$

## SYNTHESIS EXAMPLE 114

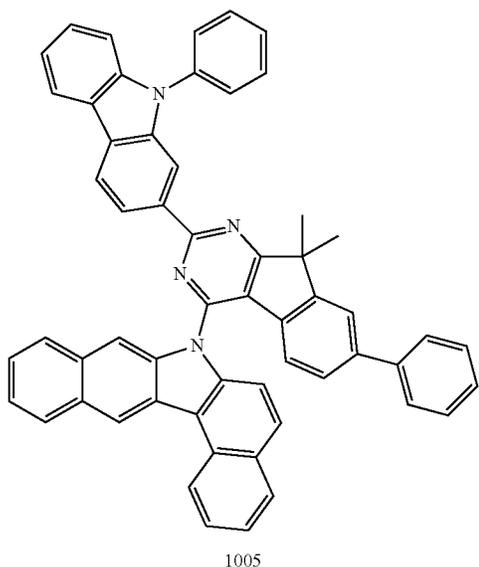
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65

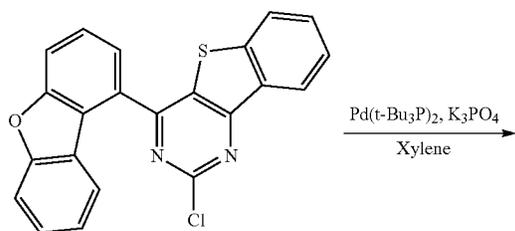
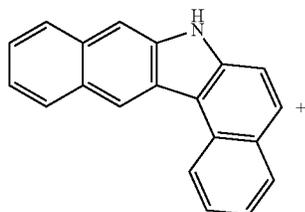
465

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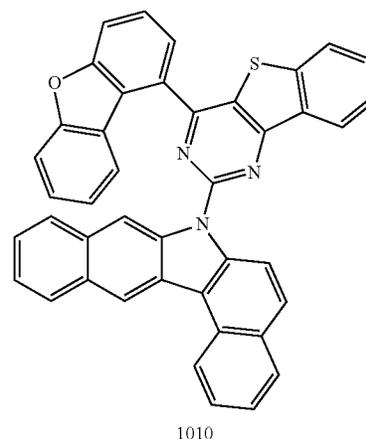
Chemical Formula d (10.0 g, 1.0 eq.), 4-chloro-9,9-dimethyl-7-phenyl-2-(9-phenyl-9H-carbazol-2-yl)-9H-indeno[2,1-d]pyrimidine (27.74 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1005 (27.74 g, yield 63%).  $[M+H]=779$

## SYNTHESIS EXAMPLE 115



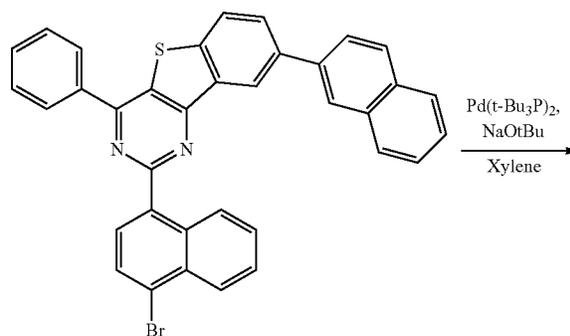
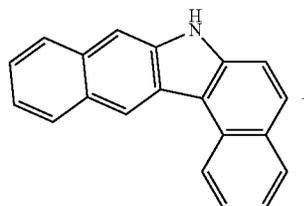
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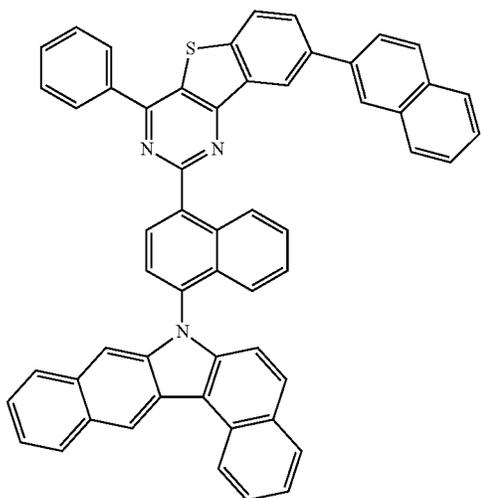
Chemical Formula d (10.0 g, 1.0 eq.), 2-chloro-4-(dibenzo[b,d]furan-1-yl)benzo[4,5]thieno[3,2-d]pyrimidine (15.91 g, 1.1 eq.),  $K_3PO_4$  (19.53 g, 2.0 eq.) and  $Pd(t-Bu_3P)_2$  (0.12 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in  $CHCl_3$ , washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1010 (15.25 g, yield 66%).  $[M+H]=618$

## SYNTHESIS EXAMPLE 116



467

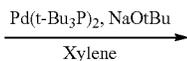
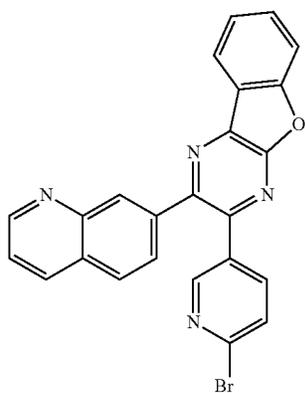
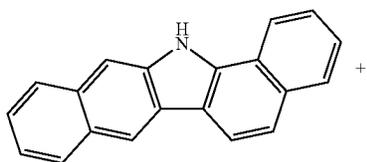
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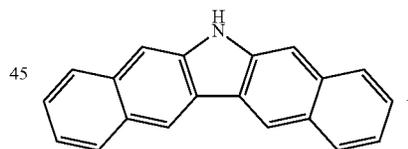
1016

Chemical Formula d (10.0 g, 1.0 eq.), 2-(4-bromonaphthalen-1-yl)-8-(naphthalen-2-yl)-4-phenylbenzo[4,5]thieno[3,2-d]pyrimidine (24.42 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1016 (17.79 g, yield 61%). [M+H]=780

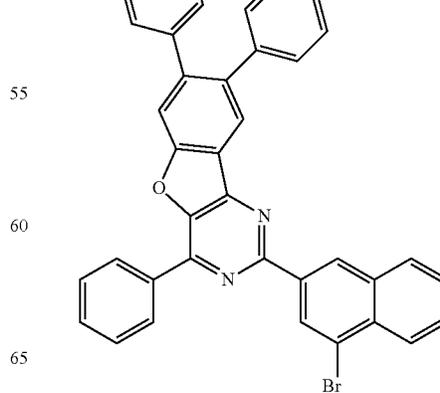
## SYNTHESIS EXAMPLE 117



40

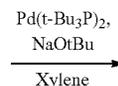


50



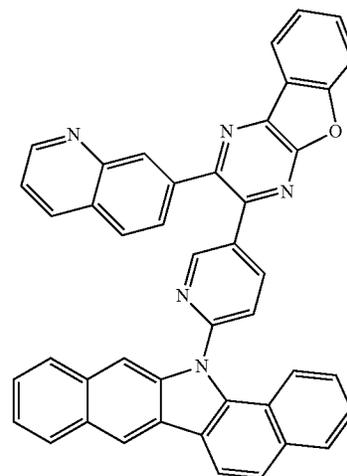
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65



468

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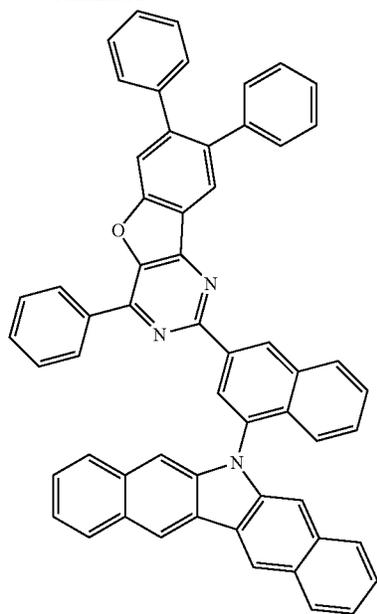
1030

Chemical Formula b (10.0 g, 1.0 eq.), 3-(6-bromopyridin-3-yl)-2-(quinolin-7-yl)benzofuro[2,3-b]pyrazine (24.83 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1030 (18.61 g, yield 63%). [M+H]=640

## SYNTHESIS EXAMPLE 118

469

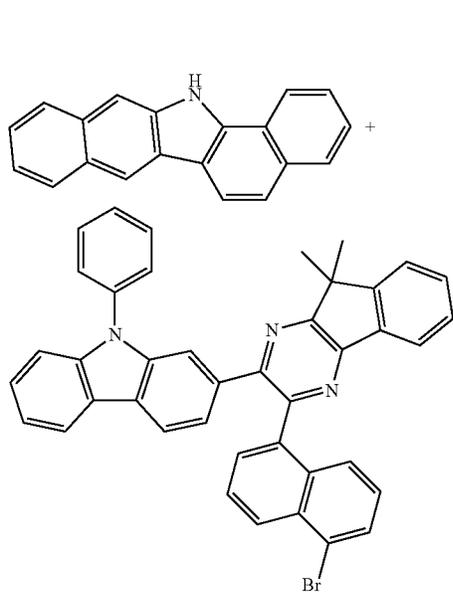
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1033

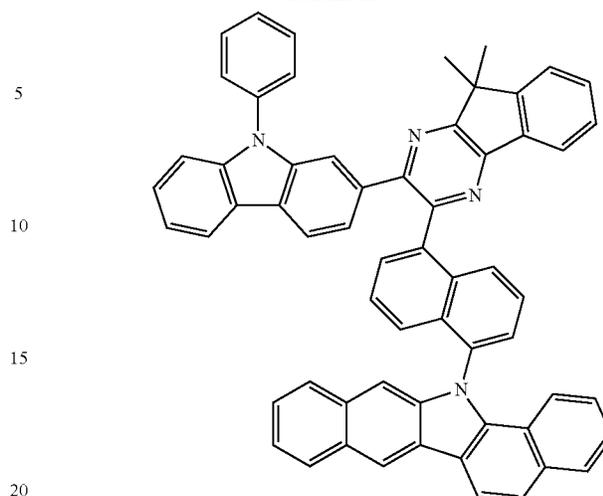
Chemical Formula c (10.0 g, 1.0 eq.), 2-(4-bromonaphthalen-2-yl)-4,7,8-triphenylbenzofuro[3,2-d]pyrimidine (18.65 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1033 (15.55 g, yield 65%). [M+H]=790

## SYNTHESIS EXAMPLE 119



470

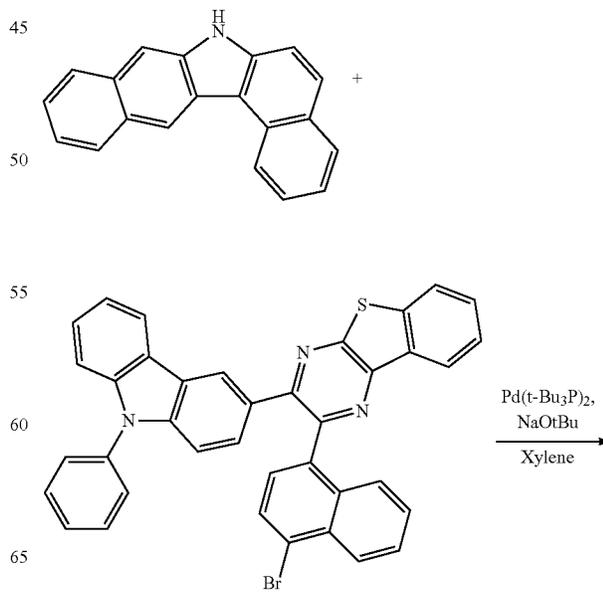
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1041

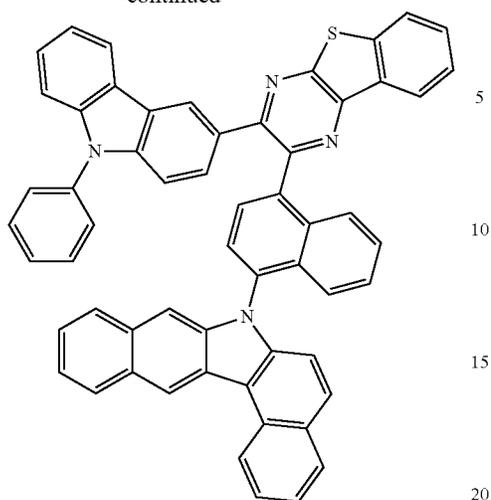
Chemical Formula b (10.0 g, 1.0 eq.), 3-(5-bromonaphthalen-1-yl)-9,9-dimethyl-2-(9-phenyl-9H-carbazol-2-yl)-9H-indeno[1,2-b]pyrazine (26.44 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1041 (18.91 g, yield 61%). [M+H]=830

## SYNTHESIS EXAMPLE 120



471

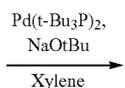
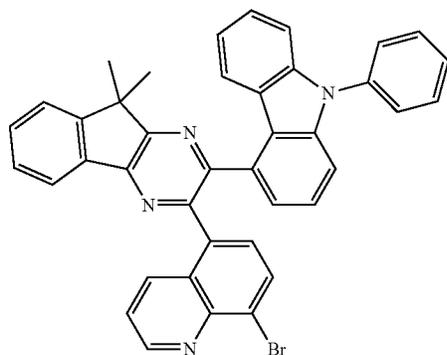
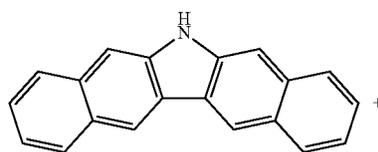
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1043

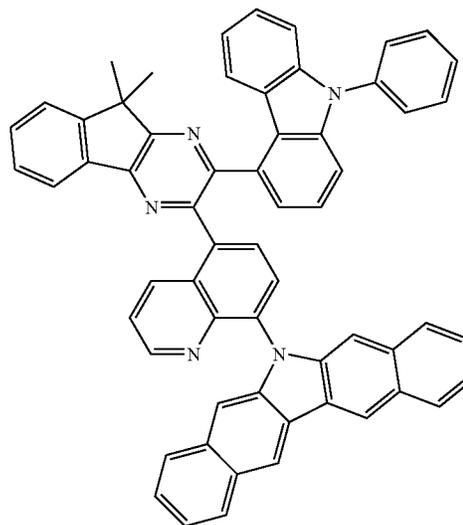
Chemical Formula d (10.0 g, 1.0 eq.), 2-(4-bromophthalen-1-yl)-3-(9-phenyl-9H-carbazol-3-yl)benzo[4,5]thieno[2,3-b]pyridine (26.02 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1043 (19.91 g, yield 65%). [M+H]=820

## SYNTHESIS EXAMPLE 121



472

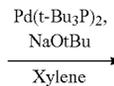
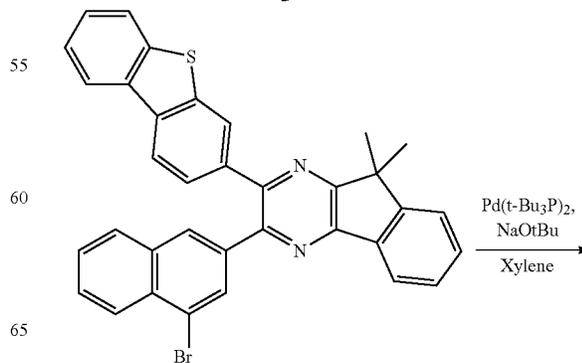
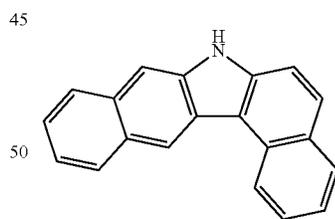
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1047

Chemical Formula c (10.0 g, 1.0 eq.), 3-(8-bromoquinolin-5-yl)-9,9-dimethyl-2-(9-phenyl-9H-carbazol-4-yl)-9H-indeno[1,2-b]pyridine (26.48 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1047 (19.24 g, yield 62%). [M+H]=831

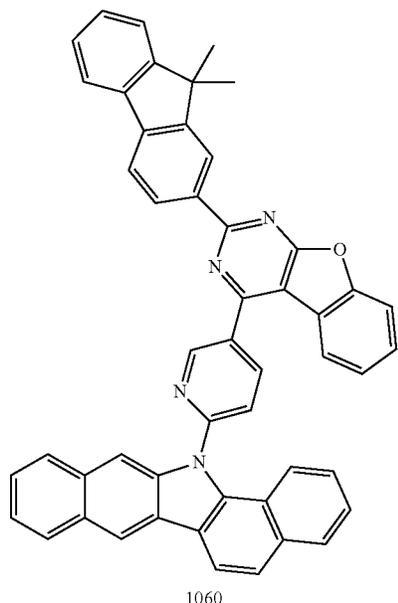
## SYNTHESIS EXAMPLE 122





475

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1060

Chemical Formula b (10.0 g, 1.0 eq.), 4-(6-bromopyridin-3-yl)-2-(9,9-dimethyl-9H-fluoren-2-yl)benzofuro[2,3-d]pyrimidine (21.33 g, 1.1 eq.), NaOtBu (7.18 g, 2.0 eq.) and Pd(t-Bu<sub>3</sub>P)<sub>2</sub> (0.10 g, 0.005 eq.) were dissolved in xylene (250 ml), and the result was stirred under reflux. When the reaction was terminated after 3 hours, the solvent was removed under vacuum. After that, the result was completely dissolved in CHCl<sub>3</sub>, washed with water, and approximately 50% of the solvent was removed under vacuum again. Under reflux again, crystals were dropped while adding ethyl acetate thereto, and the result was cooled and then filtered. This went through column chromatography to obtain Compound 1060 (16.87 g, yield 64%). [M+H]=705

476

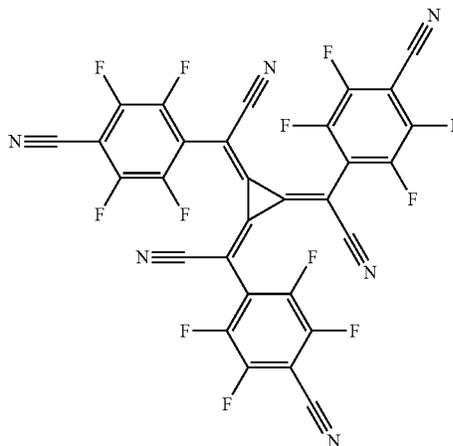
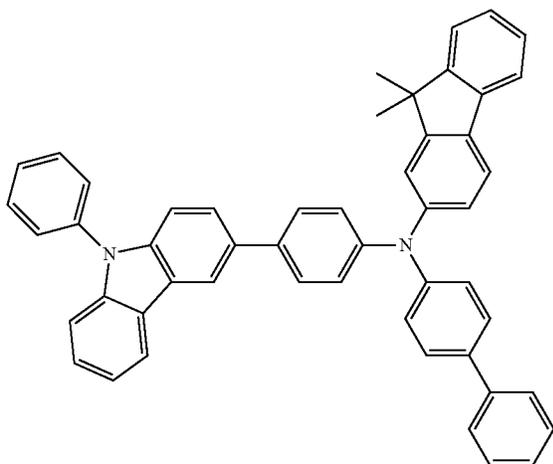
COMPARATIVE EXAMPLE 1

A glass substrate on which indium tin oxide (ITO) was coated as a thin film to a thickness of 1,000 Å was placed in detergent-dissolved distilled water and ultrasonic cleaned. Herein, a product of Fischer Co. was used as the detergent, and as the distilled water, distilled water filtered twice with a filter manufactured by Millipore Co. was used. After the ITO was cleaned for 30 minutes, ultrasonic cleaning was repeated twice using distilled water for 10 minutes. After the cleaning with distilled water was finished, the substrate was ultrasonic cleaned with solvents of isopropyl alcohol, acetone and methanol, then dried, and then transferred to a plasma cleaner. In addition, the substrate was cleaned for 5 minutes using oxygen plasma, and then transferred to a vacuum depositor.

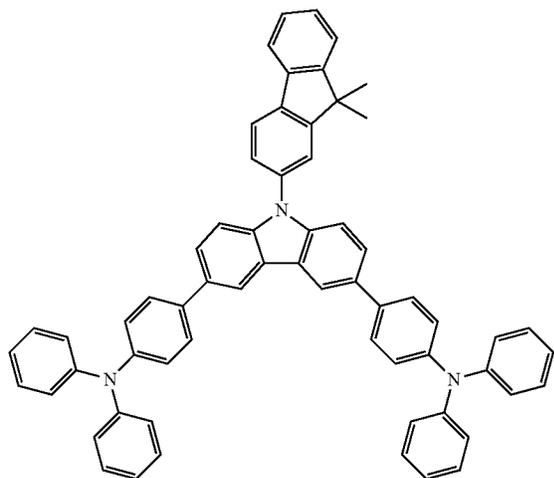
On the transparent ITO electrode prepared as above, the following HI-1 Compound was formed to a thickness of 1150 Å as a hole injection layer with the following A-1 Compound being p-doped in a concentration of 1.5%. A hole transfer layer having a film thickness of 800 Å was formed by vacuum depositing the following HT-1 Compound on the hole injection layer. Subsequently, an electron blocking layer was formed by vacuum depositing the following EB-1 Compound on the hole transfer layer to a film thickness of 150 Å. Then, on the EB-1 deposited film, a red light emitting layer having a thickness of 400 Å was formed by vacuum depositing the following RH-1 Compound and the following Dp-7 Compound in a weight ratio of 98:2. On the light emitting layer, a hole blocking layer was formed by vacuum depositing the following HB-1 Compound to a film thickness of 30 Å. Then, on the hole blocking layer, an electron injection and transfer layer was formed to a thickness of 300 Å by vacuum depositing the following ET-1 Compound and the following LiQ Compound in a weight ratio of 2:1. A cathode was formed on the electron injection and transfer layer by depositing lithium fluoride (LiF) to a thickness of 12 Å and aluminum to a thickness of 1,000 Å in consecutive order.

HI-1

A-1

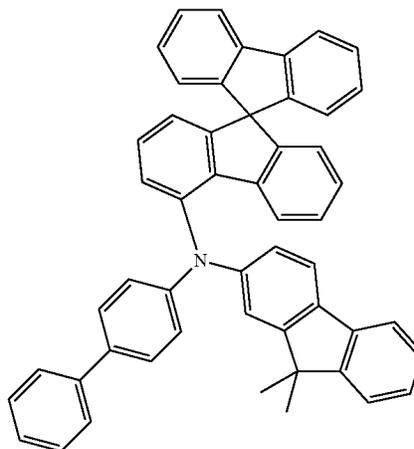


477



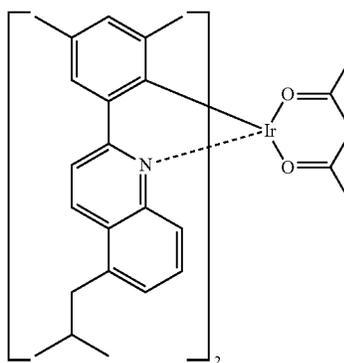
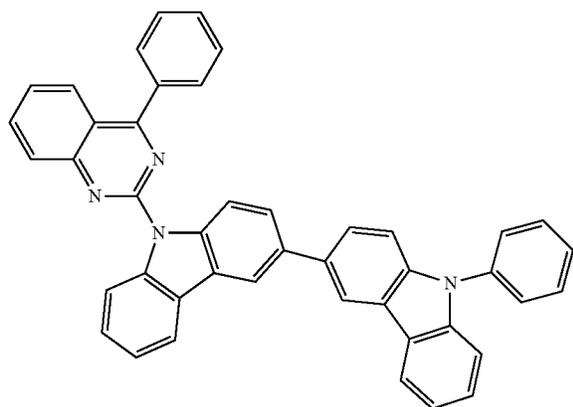
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HT-1

478

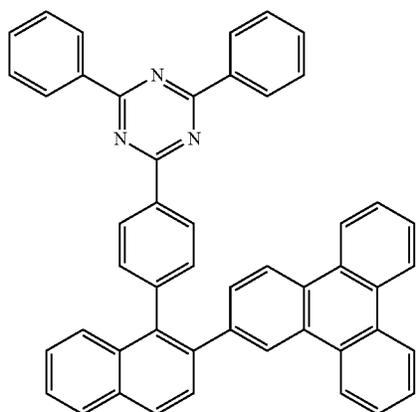


EB-1

RH-1



Dp-7



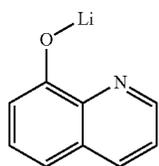
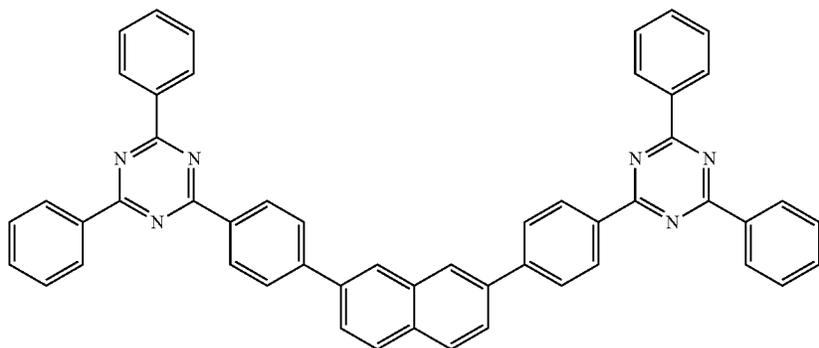
HB-1

479

480

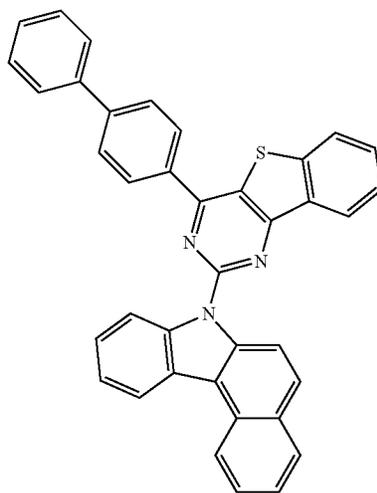
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ET-1



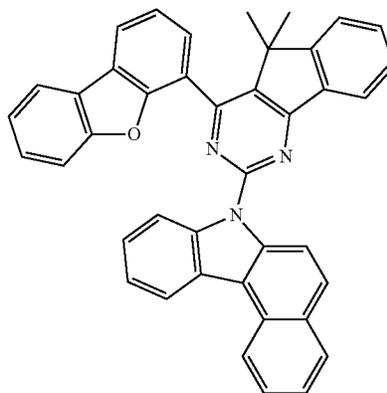
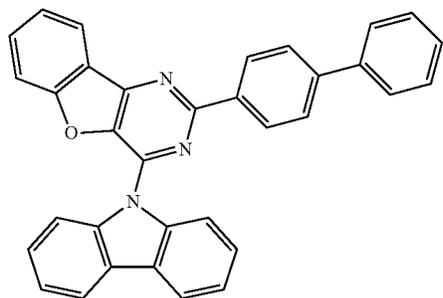
LiQ

RH-2

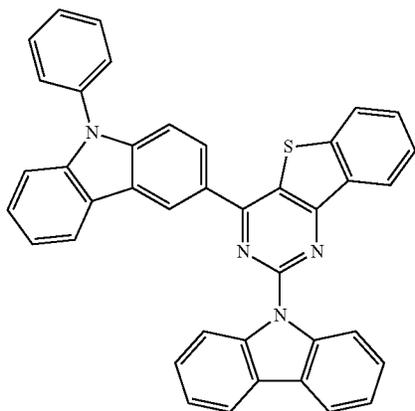


RH-3

RH-4

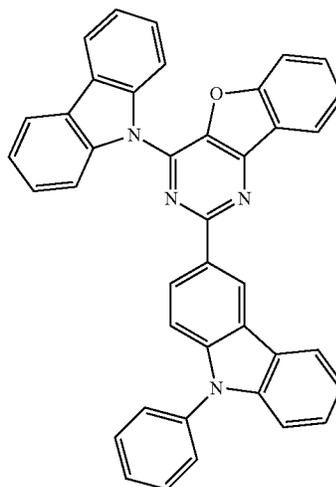


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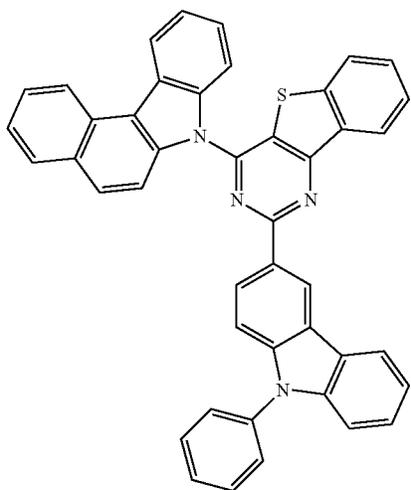
482

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RH-5

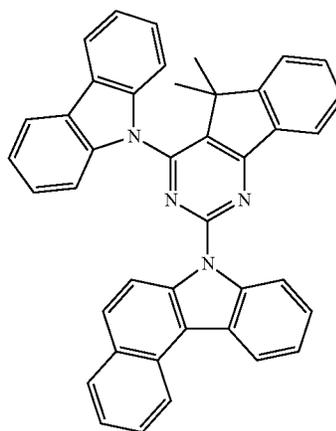


RH-6

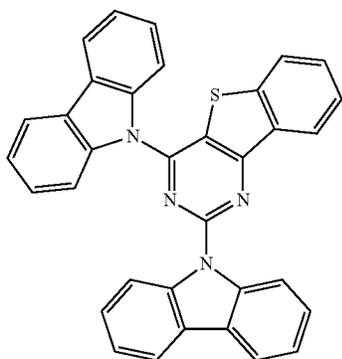
RH-7



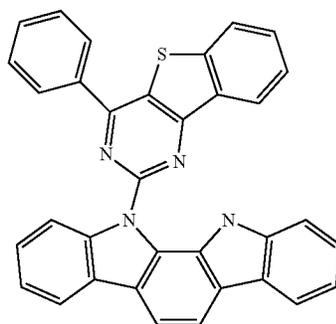
RH-8



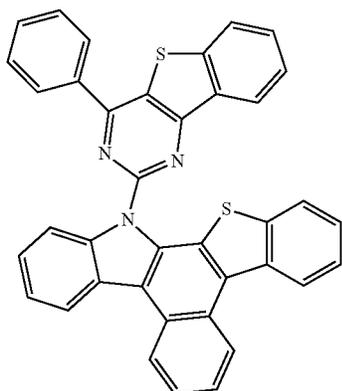
RH-9



RH-10

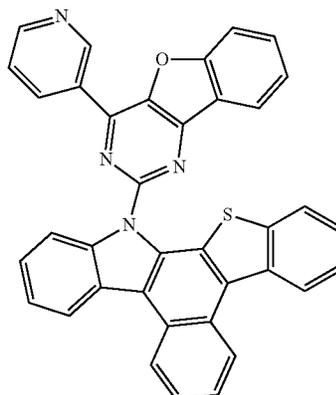


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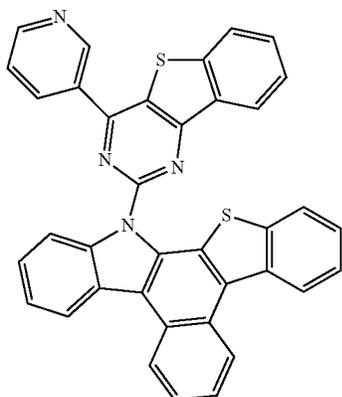


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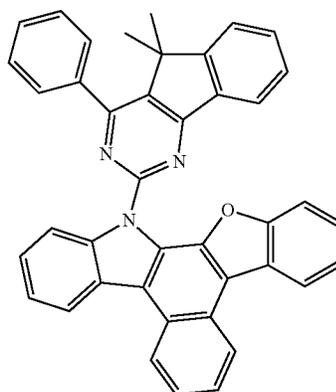
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RH-11



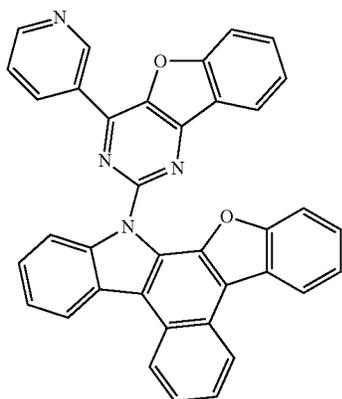
RH-12



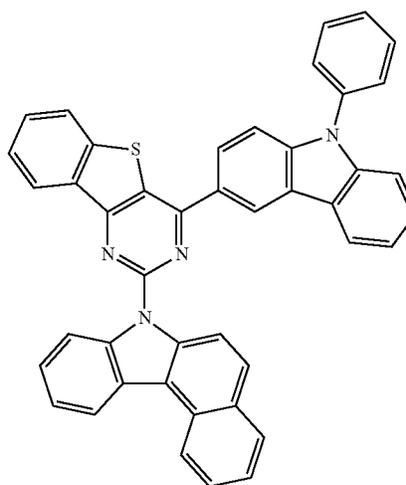
RH-13



RH-14

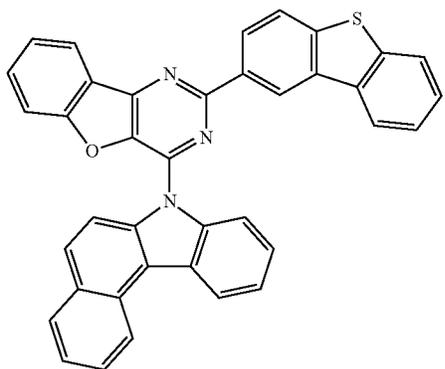


RH-15



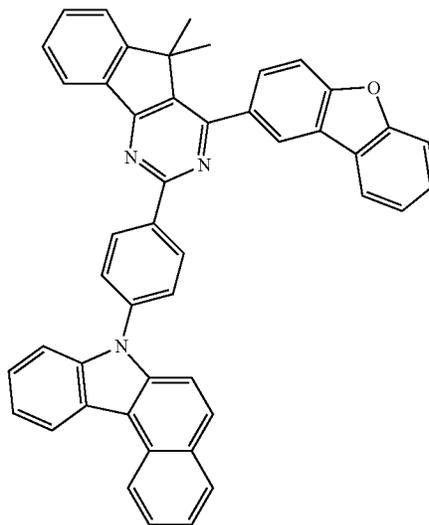
RH-16

485



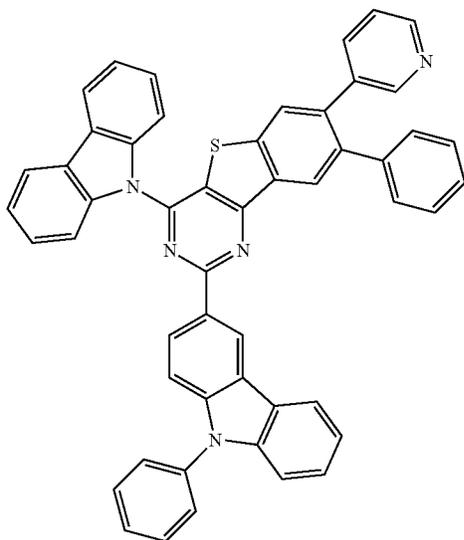
486

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RH-17



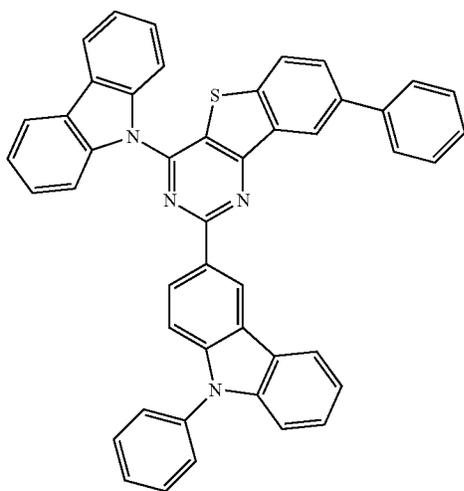
RH-18

RH-19

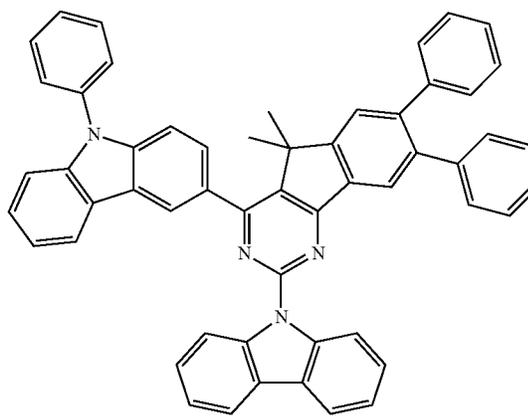


RH-20

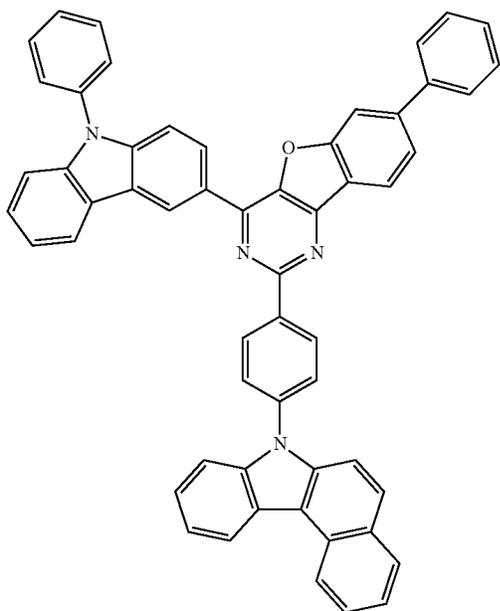
RH-21



RH-22

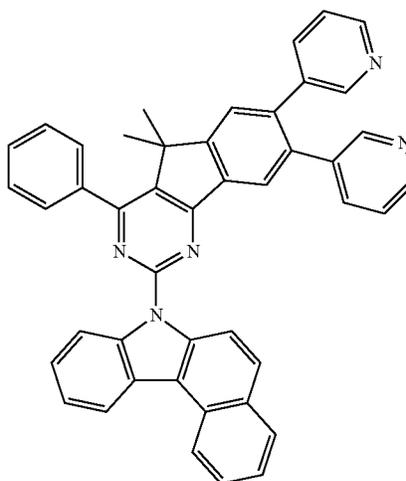


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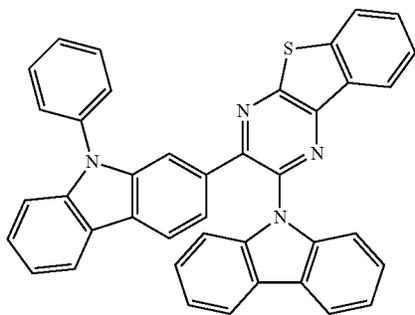


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RH-23

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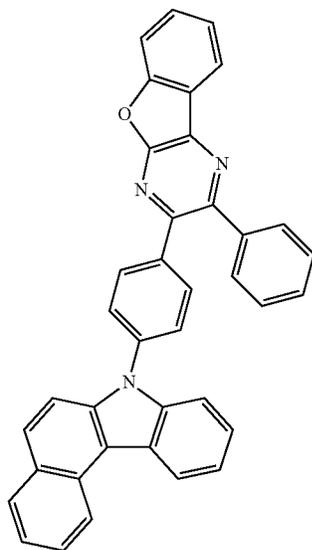


RH-24



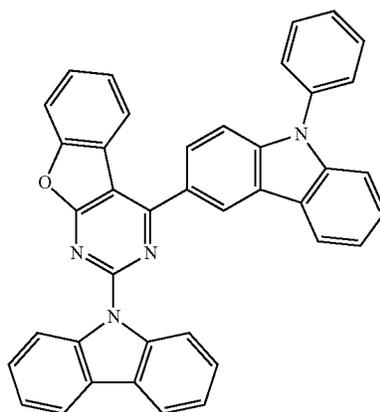
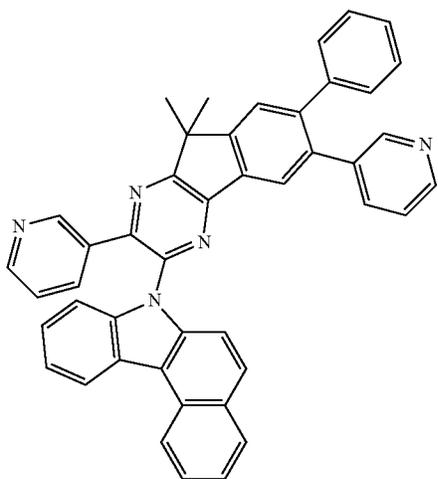
RH-25

RH-26



RH-27

RH-28

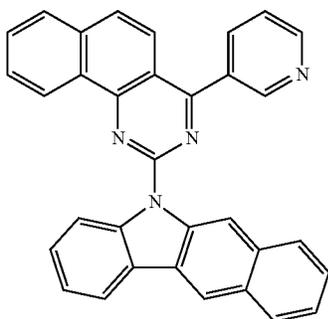
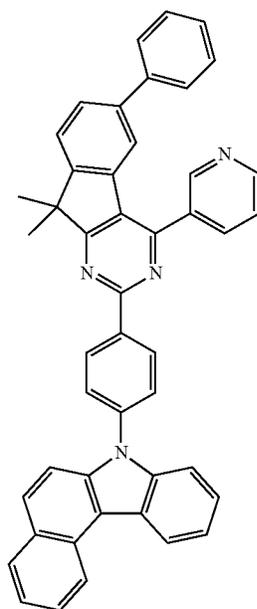
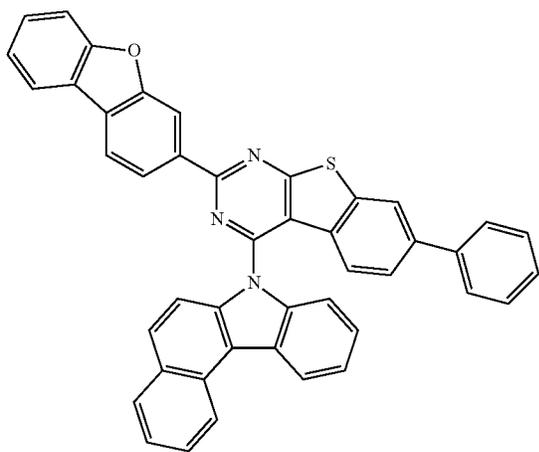


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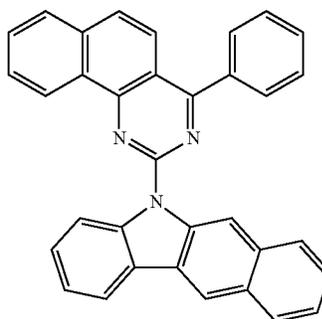
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RH-29

RH-30



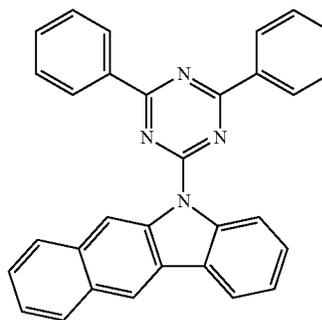
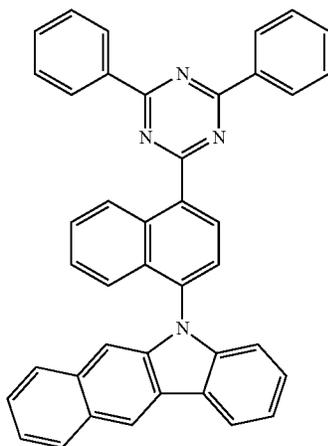
RH-31

RH-32

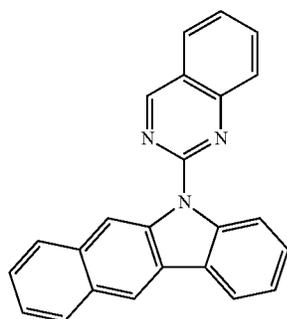
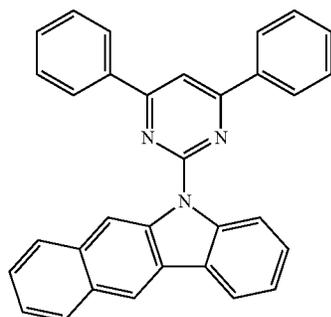


RH-33

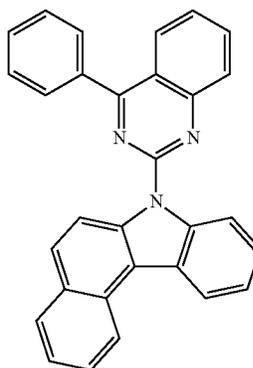
RH-34



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-continued  
RH-35

RH-36

RH-37

An organic light emitting device was manufactured by maintaining, in the above-mentioned processes, the deposition rates of the organic materials at 0.4 Å/sec to 0.7 Å/sec, the deposition rates of the lithium fluoride and the aluminum of the cathode at 0.3 Å/sec and 2 Å/sec, respectively, and the degree of vacuum during the deposition at  $2 \times 10^{-7}$  torr to  $5 \times 10^{-6}$  torr.

## EXAMPLE 1 TO EXAMPLE 124

Organic light emitting devices were manufactured in the same manner as in Comparative Example 1 except that, in organic light emitting device of Comparative Example 1, compounds described in the following Table 1 were each used instead of RH-1.

COMPARATIVE EXAMPLE 2 TO  
COMPARATIVE EXAMPLE 37

Organic light emitting devices were manufactured in the same manner as in Comparative Example 1 except that, in organic light emitting device of Comparative Example 1, compounds described in the following Table 1 were each used instead of RH-1.

When a current was applied to the organic light emitting devices manufactured in Example 1 to Example 124, and Comparative Example 1 to Comparative Example 37, a voltage, efficiency and a lifetime were measured, and the results are shown in the following Table 1. T95 means time taken for the luminance decreasing to 95% from its initial luminance (5000 nit).

TABLE 1

Category	Material	Driving Voltage (V)	Efficiency (cd/A)	Lifetime T95 (hr)	Light Emitting Color
35	RH-1	4.55	33.1	191	Red
40	Compound 5	4.22	35.5	275	Red
	Compound 29	4.29	36.7	290	Red
	Compound 40	3.98	39.4	305	Red
45	Compound 42	3.89	40.5	316	Red
	Compound 43	3.91	38.1	301	Red
	Compound 53	3.95	39.8	305	Red
50	Compound 56	4.07	37.6	311	Red
	Compound 60	4.05	38.4	297	Red
	Compound 66	4.20	39.9	285	Red
55	Compound 68	3.94	38.1	320	Red
	Compound 88	4.21	39.1	307	Red
	Compound 91	4.17	39.5	295	Red
60	Compound 93	3.80	38.7	297	Red
	Compound 119	3.81	40.5	286	Red
	Compound 120	4.03	40.7	335	Red
65	Compound 123	3.91	40.5	257	Red

TABLE 1-continued

Category	Material	Driving Voltage (V)	Efficiency (cd/A)	Lifetime T95 (hr)	Light Emitting Color
Example 17	Compound 130	3.95	39.1	293	Red
Example 18	Compound 133	3.97	39.7	273	Red
Example 19	Compound 144	3.98	41.3	289	Red
Example 20	Compound 149	4.11	39.3	301	Red
Example 21	Compound 167	3.90	39.1	274	Red
Example 22	Compound 175	3.95	39.7	275	Red
Example 23	Compound 182	4.06	37.3	280	Red
Example 24	Compound 194	4.01	38.8	267	Red
Example 25	Compound 201	4.13	37.3	313	Red
Example 26	Compound 214	3.75	40.3	341	Red
Example 27	Compound 217	4.25	38.3	326	Red
Example 28	Compound 218	3.87	42.7	310	Red
Example 29	Compound 221	3.79	40.3	332	Red
Example 30	Compound 233	3.82	42.3	357	Red
Example 31	Compound 237	3.89	40.8	290	Red
Example 32	Compound 244	3.80	41.1	341	Red
Example 33	Compound 254	3.99	36.9	290	Red
Example 34	Compound 267	4.05	37.7	314	Red
Example 35	Compound 278	4.09	38.1	262	Red
Example 36	Compound 284	3.82	40.1	324	Red
Example 37	Compound 292	3.97	41.5	319	Red
Example 38	Compound 296	3.90	40.0	330	Red
Example 39	Compound 329	3.85	41.4	353	Red
Example 40	Compound 334	3.91	40.6	371	Red
Example 41	Compound 341	3.99	39.1	349	Red
Example 42	Compound 375	3.96	40.5	340	Red
Example 43	Compound 383	3.81	42.1	329	Red
Example 44	Compound 412	3.75	43.4	357	Red
Example 45	Compound 422	3.70	41.0	372	Red
Example 46	Compound 423	3.73	40.3	334	Red
Example 47	Compound 450	3.86	42.8	339	Red
Example 48	Compound 451	3.85	39.8	350	Red
Example 49	Compound 463	3.81	37.9	324	Red
Example 50	Compound 464	3.92	35.5	319	Red
Example 51	Compound 472	3.97	35.0	328	Red
Example 52	Compound 480	3.90	41.3	342	Red
Example 53	Compound 495	3.84	39.3	310	Red
Example 54	Compound 496	3.87	42.3	337	Red

TABLE 1-continued

Category	Material	Driving Voltage (V)	Efficiency (cd/A)	Lifetime T95 (hr)	Light Emitting Color
Example 55	Compound 501	3.90	40.8	321	Red
Example 56	Compound 503	3.71	42.7	325	Red
Example 57	Compound 509	3.74	40.5	329	Red
Example 58	Compound 589	3.77	38.1	342	Red
Example 59	Compound 590	3.75	42.7	365	Red
Example 60	Compound 591	3.89	41.1	347	Red
Example 61	Compound 592	3.80	39.5	323	Red
Example 62	Compound 599	3.99	39.5	360	Red
Example 63	Compound 602	4.02	38.7	357	Red
Example 64	Compound 606	3.91	37.5	341	Red
Example 65	Compound 608	3.95	38.1	332	Red
Example 66	Compound 613	3.90	38.7	348	Red
Example 67	Compound 619	3.93	40.3	337	Red
Example 68	Compound 636	3.84	38.3	341	Red
Example 69	Compound 697	4.23	35.1	273	Red
Example 70	Compound 701	3.68	38.7	295	Red
Example 71	Compound 707	3.65	39.3	285	Red
Example 72	Compound 713	4.20	37.8	267	Red
Example 73	Compound 717	4.15	38.3	234	Red
Example 74	Compound 724	3.99	37.3	241	Red
Example 75	Compound 726	4.13	39.3	307	Red
Example 76	Compound 739	4.07	38.7	273	Red
Example 77	Compound 740	4.01	39.3	232	Red
Example 78	Compound 743	4.11	40.3	226	Red
Example 79	Compound 744	4.04	39.8	243	Red
Example 80	Compound 745	4.10	40.1	238	Red
Example 81	Compound 764	3.74	40.9	291	Red
Example 82	Compound 778	4.00	39.7	265	Red
Example 83	Compound 781	3.91	38.1	260	Red
Example 84	Compound 790	3.99	37.5	257	Red
Example 85	Compound 794	4.17	40.0	288	Red
Example 86	Compound 795	4.11	40.5	293	Red
Example 87	Compound 798	4.07	41.2	269	Red
Example 88	Compound 809	3.82	40.4	339	Red
Example 89	Compound 811	3.94	37.1	249	Red
Example 90	Compound 818	3.95	40.1	311	Red
Example 91	Compound 822	3.99	42.2	293	Red
Example 92	Compound 831	3.87	43.1	280	Red

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TABLE 1-continued

Category	Material	Driving Voltage (V)	Efficiency (cd/A)	Lifetime T95 (hr)	Light Emitting Color
Example 93	Compound 838	3.73	42.0	297	Red
Example 94	Compound 844	3.84	40.4	281	Red
Example 95	Compound 848	3.80	43.7	282	Red
Example 96	Compound 861	4.01	38.6	272	Red
Example 97	Compound 863	3.88	39.3	352	Red
Example 98	Compound 866	3.96	36.3	291	Red
Example 99	Compound 867	3.81	37.8	284	Red
Example 100	Compound 869	3.99	41.3	313	Red
Example 101	Compound 870	3.80	42.3	330	Red
Example 102	Compound 871	4.05	40.3	360	Red
Example 103	Compound 874	3.90	40.5	371	Red
Example 104	Compound 876	4.01	41.7	350	Red
Example 105	Compound 878	4.06	42.5	271	Red
Example 106	Compound 890	3.87	41.4	357	Red
Example 107	Compound 898	3.89	39.7	351	Red
Example 108	Compound 912	3.90	40.1	321	Red
Example 109	Compound 913	3.97	40.0	357	Red
Example 110	Compound 919	3.92	42.7	315	Red
Example 111	Compound 933	3.95	39.5	327	Red
Example 112	Compound 937	3.90	39.9	323	Red
Example 113	Compound 941	3.94	38.7	336	Red
Example 114	Compound 1005	3.94	41.3	328	Red
Example 115	Compound 1010	4.00	39.3	354	Red
Example 116	Compound 1016	4.05	37.1	292	Red
Example 117	Compound 1030	4.19	39.7	251	Red
Example 118	Compound 1033	4.24	39.3	245	Red
Example 119	Compound 1041	4.21	38.8	267	Red
Example 120	Compound 1043	3.93	39.5	304	Red
Example 121	Compound 1047	4.16	37.4	261	Red
Example 122	Compound 1053	4.11	39.0	277	Red
Example 123	Compound 1055	4.20	41.7	250	Red
Example 124	Compound 1060	4.25	40.1	243	Red
Comparative Example 2	RH-2	4.43	35.2	182	Red
Comparative Example 3	RH-3	4.50	34.1	205	Red
Comparative Example 4	RH-4	4.40	34.1	206	Red
Comparative Example 5	RH-5	4.58	35.0	217	Red
Comparative Example 6	RH-6	4.41	33.4	179	Red
Comparative Example 7	RH-7	4.67	29.7	161	Red

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TABLE 1-continued

Category	Material	Driving Voltage (V)	Efficiency (cd/A)	Lifetime T95 (hr)	Light Emitting Color
Comparative Example 8	RH-8	4.41	34.0	163	Red
Comparative Example 9	RH-9	4.39	35.7	184	Red
Comparative Example 10	RH-10	4.51	33.3	204	Red
Comparative Example 11	RH-11	4.43	35.2	208	Red
Comparative Example 12	RH-12	4.33	34.2	171	Red
Comparative Example 13	RH-13	4.51	35.1	180	Red
Comparative Example 14	RH-14	4.40	34.1	161	Red
Comparative Example 15	RH-15	4.58	31.0	177	Red
Comparative Example 16	RH-16	4.31	30.4	201	Red
Comparative Example 17	RH-17	4.47	29.7	140	Red
Comparative Example 18	RH-18	4.21	32.0	169	Red
Comparative Example 19	RH-19	4.29	35.7	184	Red
Comparative Example 20	RH-20	4.31	31.3	103	Red
Comparative Example 21	RH-21	4.23	35.2	97	Red
Comparative Example 22	RH-22	4.33	36.2	207	Red
Comparative Example 23	RH-23	4.51	34.1	176	Red
Comparative Example 24	RH-24	4.30	37.1	167	Red
Comparative Example 25	RH-25	4.47	34.0	179	Red
Comparative Example 26	RH-26	4.45	32.4	190	Red
Comparative Example 27	RH-27	4.37	29.7	131	Red
Comparative Example 28	RH-28	4.41	32.0	197	Red
Comparative Example 29	RH-29	4.39	33.7	137	Red
Comparative Example 30	RH-30	4.61	31.0	169	Red
Comparative Example 31	RH-31	4.13	37.7	196	Red
Comparative Example 32	RH-32	4.10	35.6	162	Red
Comparative Example 33	RH-33	4.15	35.1	161	Red
Comparative Example 34	RH-34	4.19	34.7	144	Red
Comparative Example 35	RH-35	4.11	35.0	133	Red
Comparative Example 36	RH-36	4.71	32.1	126	Red
Comparative Example 37	RH-37	4.41	28.4	97	Red

55 When applying a current to the organic light emitting devices manufactured in Examples 1 to 124 and Comparative Examples 1 to 37, results of Table 1 were obtained. The red organic light emitting device of Comparative Example 1 used materials that have been widely used in the art, and had a structure using Compound [EB-1] as an electron blocking layer and using RH-1/Dp-7 as a red light emitting layer. Comparative Examples 2 to 37 manufactured organic light emitting devices using RH-2 to RH-37 instead of RH-1.

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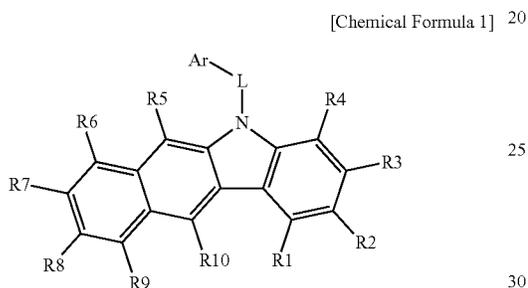
65 When examining the results of Table 1, it was seen that, when using the compound of the present disclosure as a host of a red light emitting layer, energy transfer from a host to

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a red dopant was well achieved from the fact that a driving voltage decreased closer to as much as 30% and efficiency increased by 30% or greater compared to the materials in the comparative examples. In addition, it was seen that lifetime properties were greatly improved by a factor of two or more while maintaining high efficiency. This may ultimately be due to the fact that the compounds of the present disclosure have higher stability for electrons and holes compared to the compounds of the comparative examples. As a result, it can be identified that, when using the compound of the present disclosure as a host of a red light emitting layer, a driving voltage, light emission efficiency and lifetime properties of an organic light emitting device are improved.

The invention claimed is:

1. A compound represented by the following Chemical Formula 1:

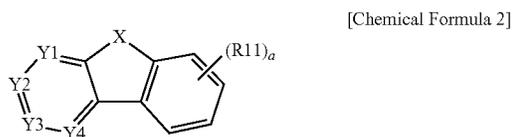


wherein in Chemical Formula 1,

R1 to R4 are hydrogen; deuterium; or bonded to adjacent group among R1 to R4 to form an aryl group having 6 to 60 carbon atoms,

R5 to R10 are each independently hydrogen or deuterium, L is a direct bond; a substituted or unsubstituted arylene group; or a substituted or unsubstituted heterocyclic group, and

Ar is represented by the following Chemical Formula 2,



in Chemical Formula 2,

two of Y1 to Y4 are N, and the remaining two are C which is a bonding site to L and CR,

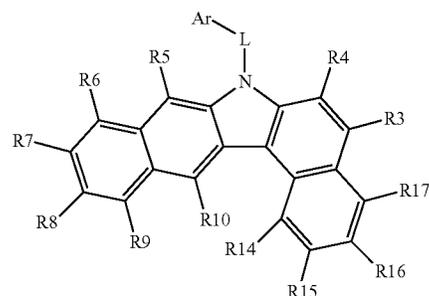
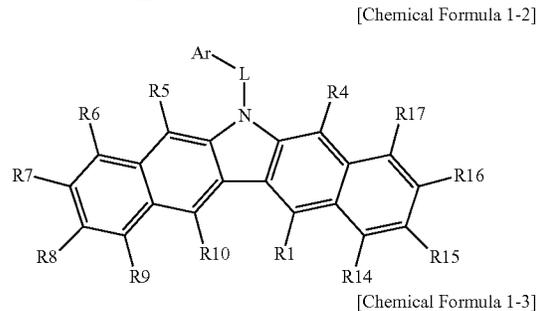
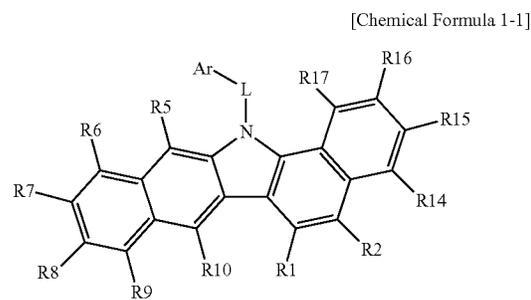
X is O or S,

R and R11 are each independently hydrogen; deuterium; a halogen group; a nitrile group; a nitro group; a hydroxyl group; an aryloxy group; an alkylthioxy group; an arylthioxy group; an alkylsulfoxy group; an arylsulfoxy group; a silyl group; a boron group; a substituted or unsubstituted alkyl group; a substituted or unsubstituted cycloalkyl group; a substituted or unsubstituted alkenyl group; a substituted or unsubstituted aryl group; a substituted or unsubstituted aralkyl group; a substituted or unsubstituted alkylamine group; a substituted or unsubstituted aralkylamine group; a substituted or unsubstituted heteroarylamine group; a substituted or unsubstituted arylamine group; a substituted or unsubstituted arylheteroarylamine group; a

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substituted or unsubstituted arylphosphine group; or a substituted or unsubstituted heterocyclic group, a is an integer of 1 to 4, and when a is 2 or greater, two or more R11s are the same as or different from each other.

2. The compound of claim 1, wherein Chemical Formula 1 is represented by any one selected from among the following Chemical Formulae 1-1 to 1-3:



wherein in Chemical Formulae 1-1 to 1-3,

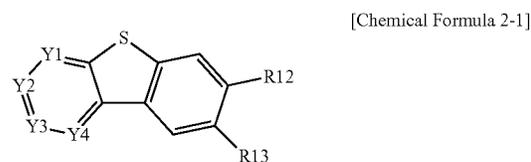
R1 to R10, Ar and L have the same definitions as in claim 1, and

R14 to R17 are each independently hydrogen or deuterium.

3. The compound of claim 1, wherein R is a substituted or unsubstituted aryl group;

or a substituted or unsubstituted heterocyclic group.

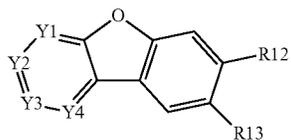
4. The compound of claim 1, wherein Chemical Formula 2 is represented by any one selected from among the following Chemical Formulae 2-1 and 2-2:



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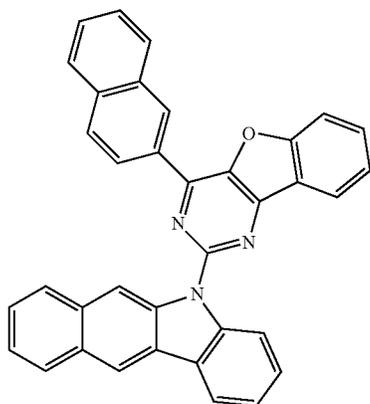
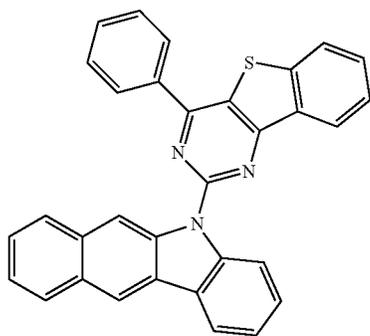
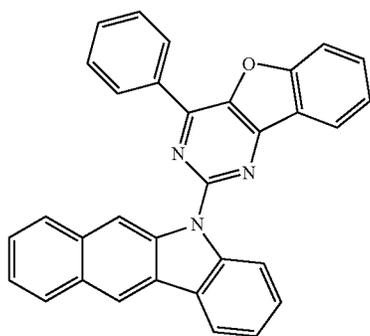
[Chemical Formula 2-2]



wherein in Chemical Formulae 2-1 and 2-2,

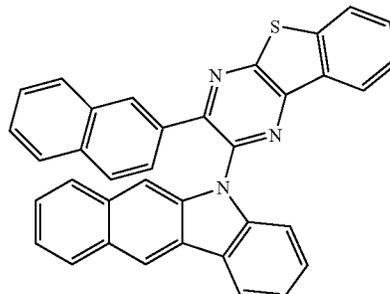
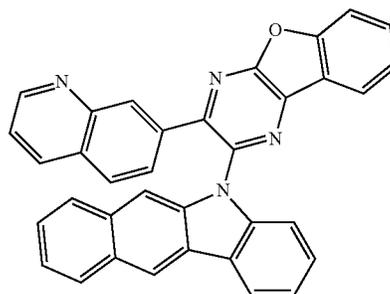
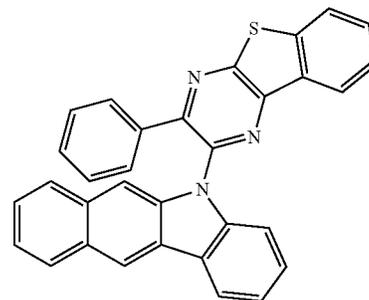
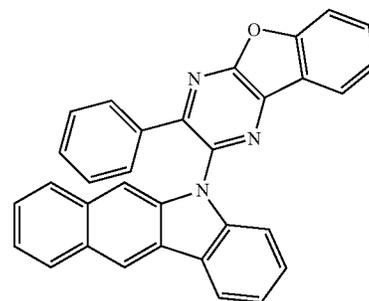
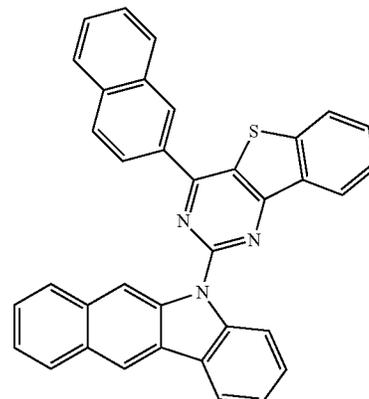
Y1 to Y4 are the same as in claim 1, and R12 and R13 each independently have the same definition as R11 of claim 1.

5. The compound of claim 1, wherein the compound represented by Chemical Formula 1 is selected from among the following compounds:



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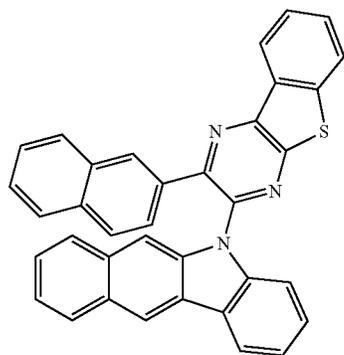
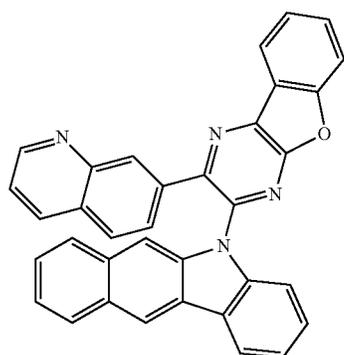
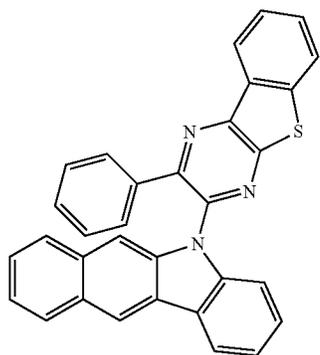
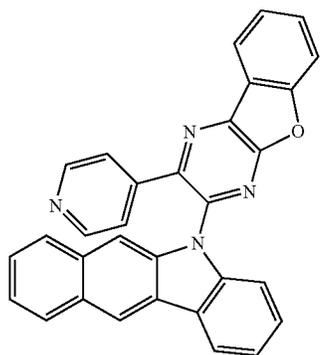
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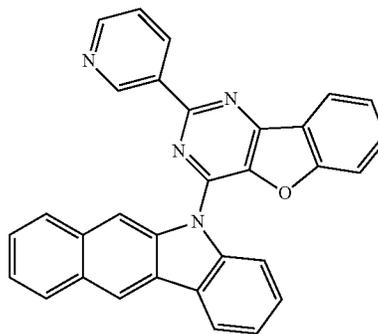
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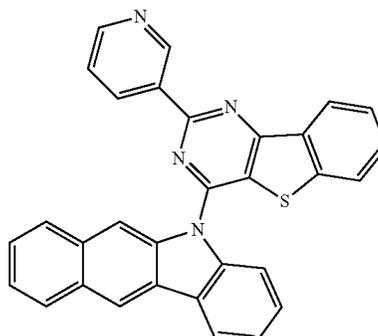
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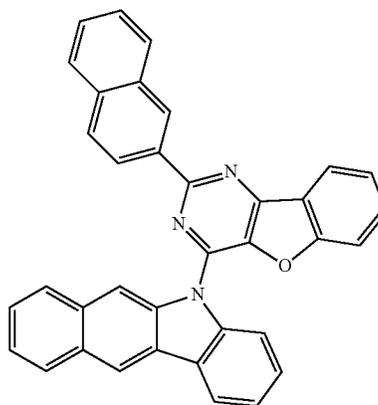


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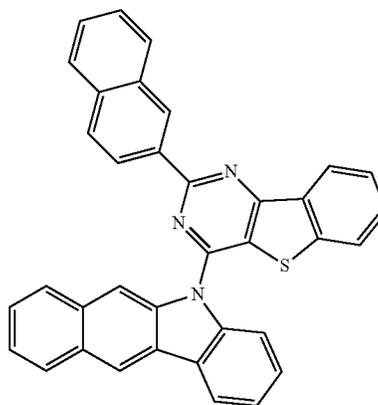
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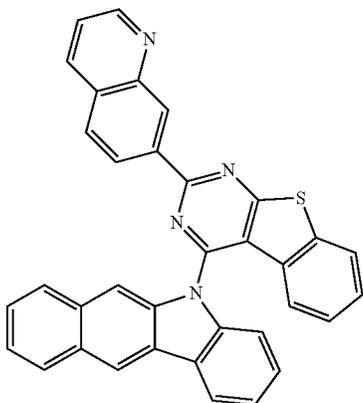
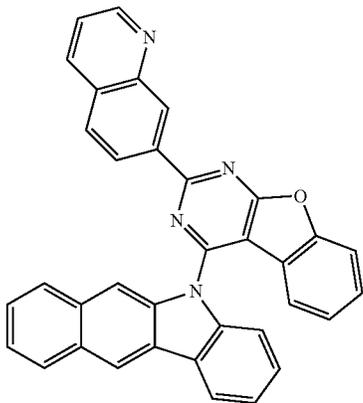
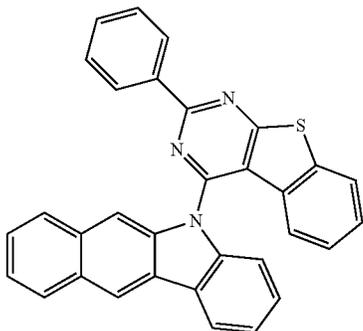
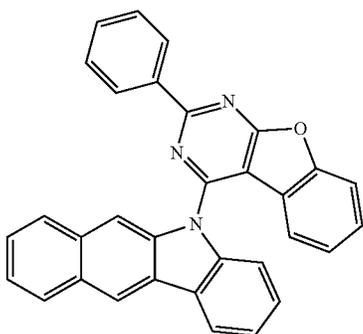


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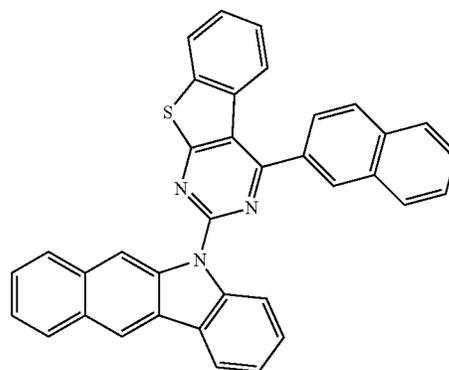
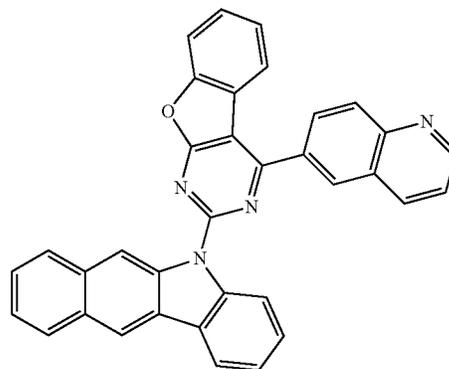
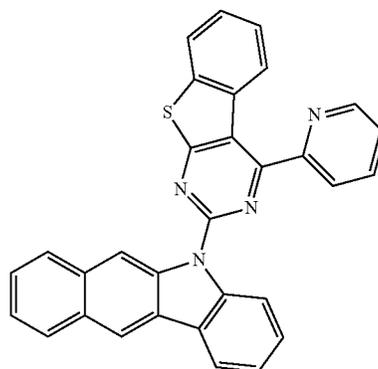
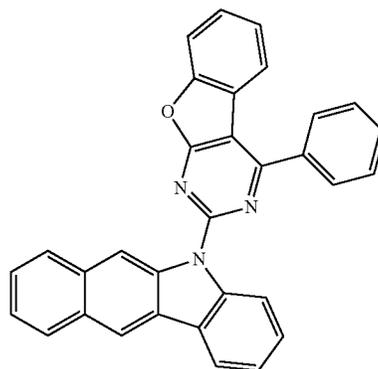
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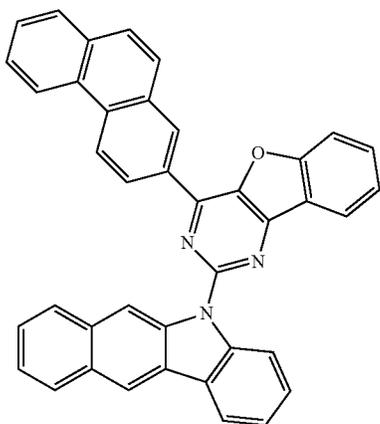
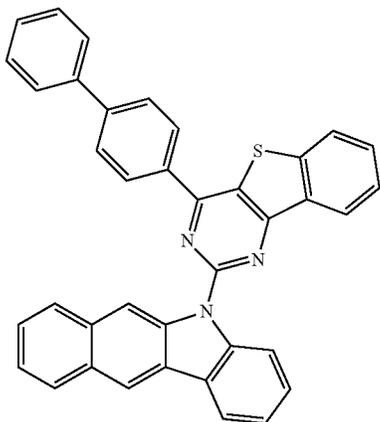
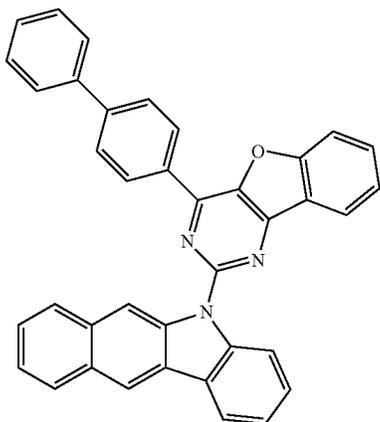
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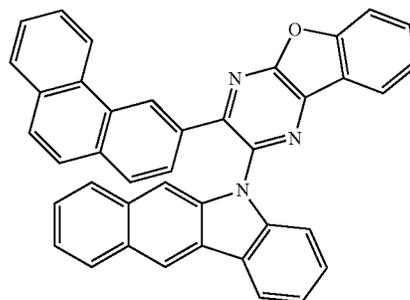
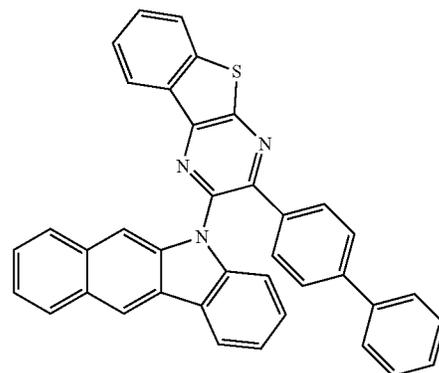
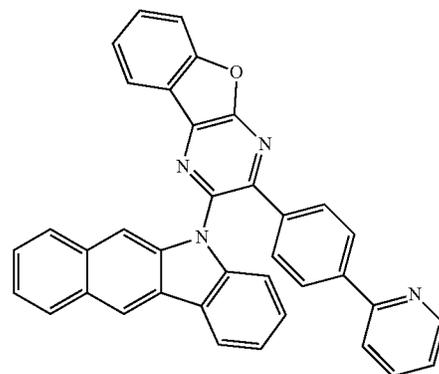
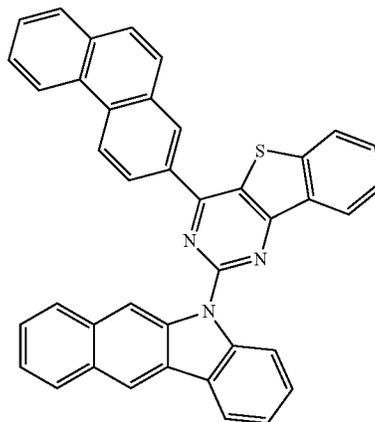
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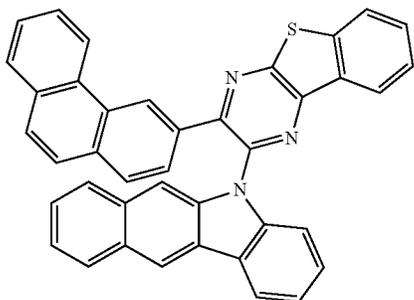
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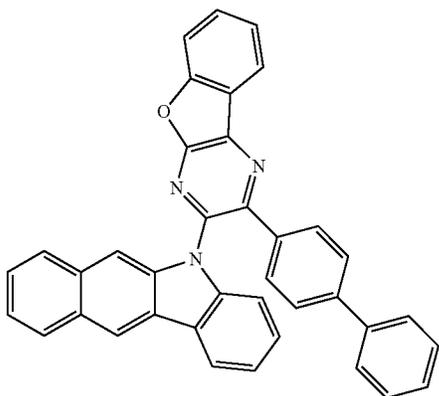


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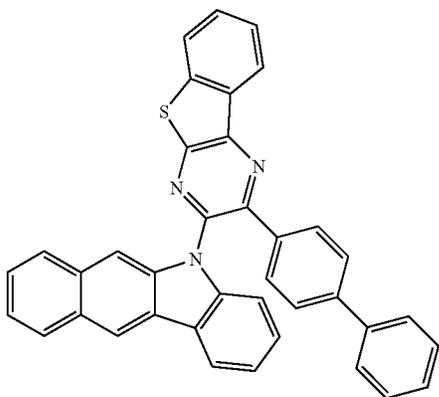


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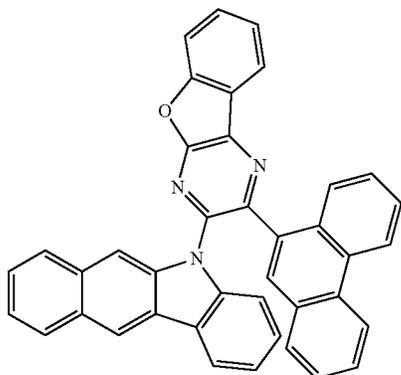


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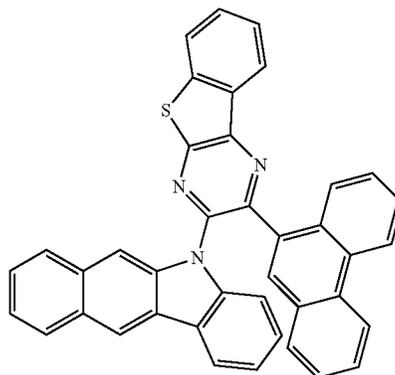
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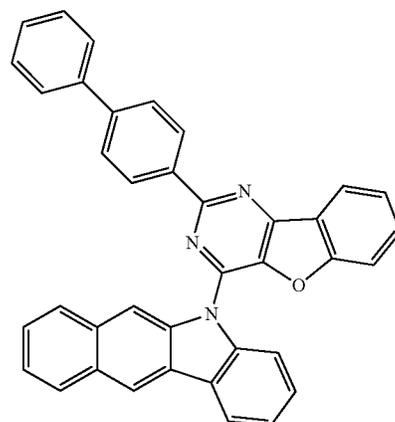
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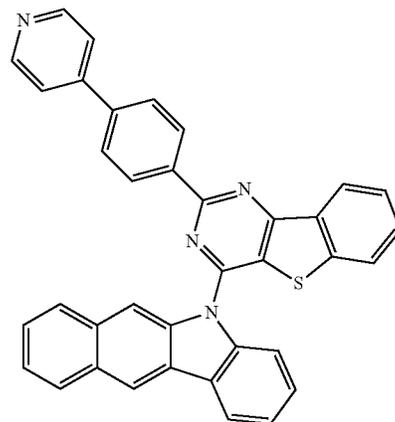
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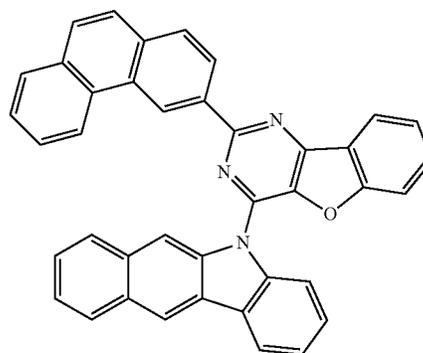


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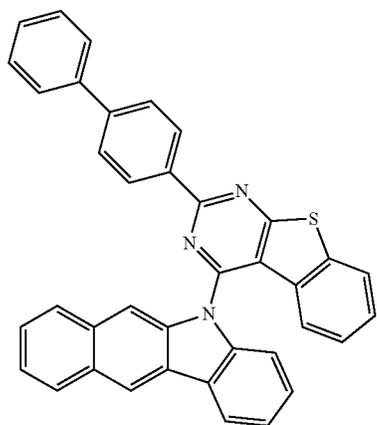
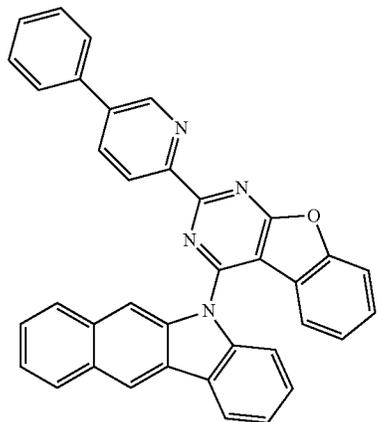
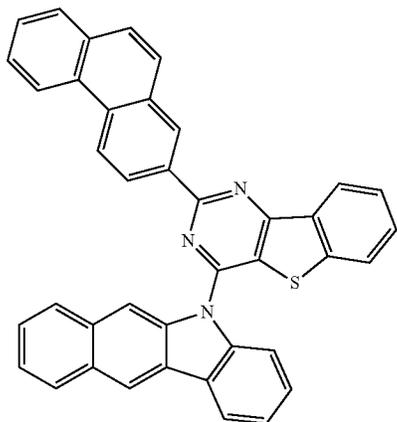
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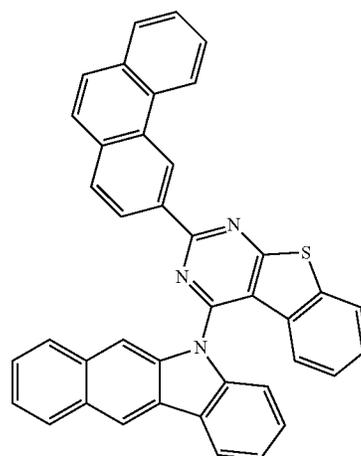
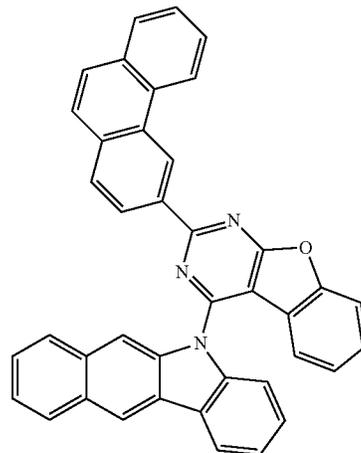
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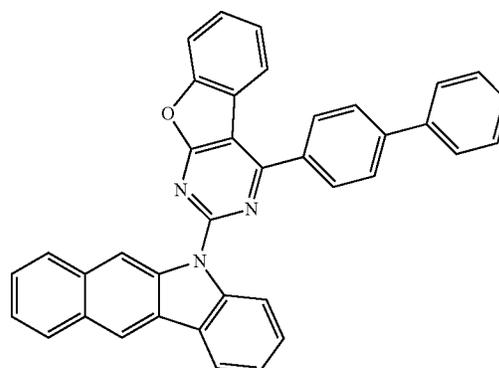
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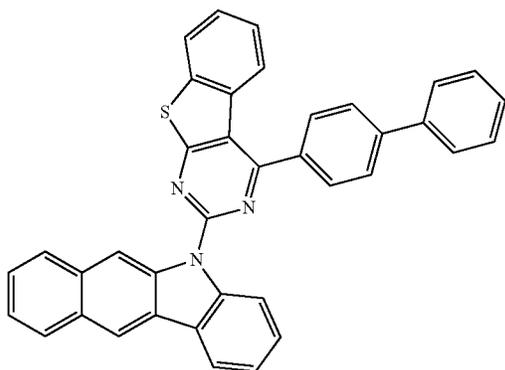
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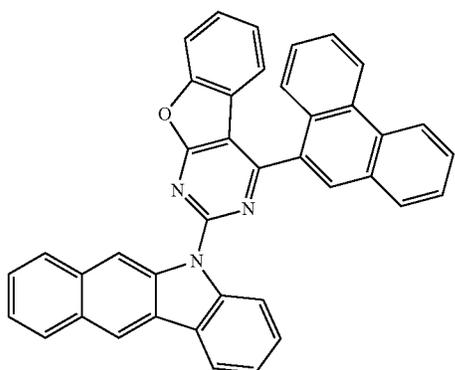
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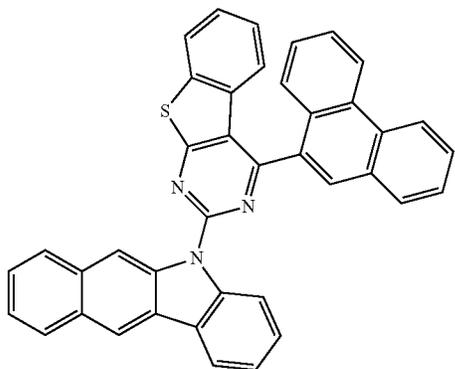


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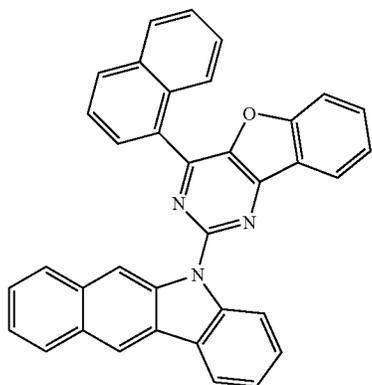
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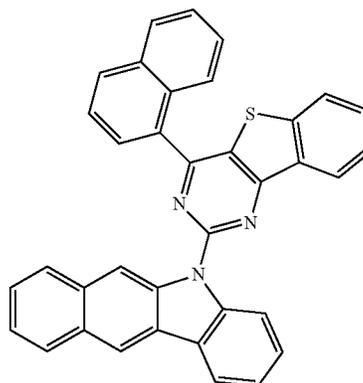
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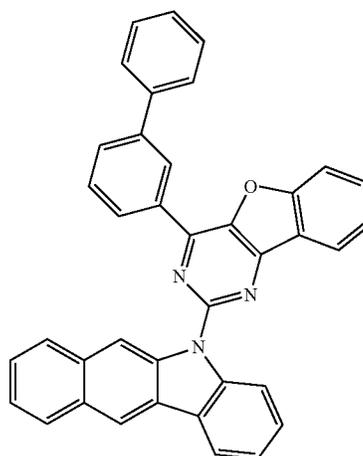
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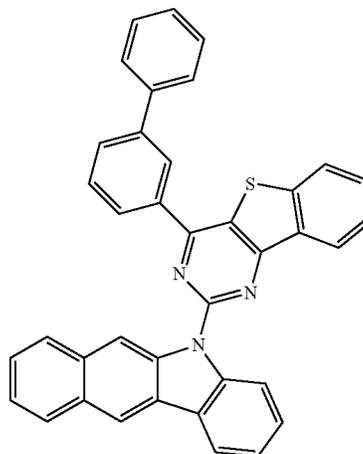
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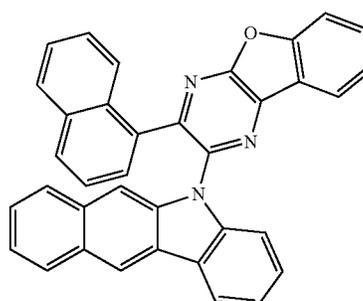
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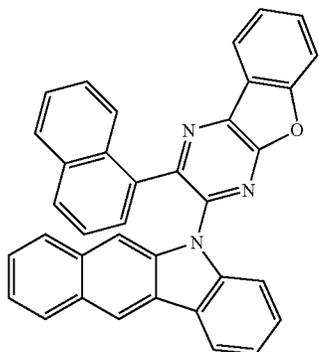
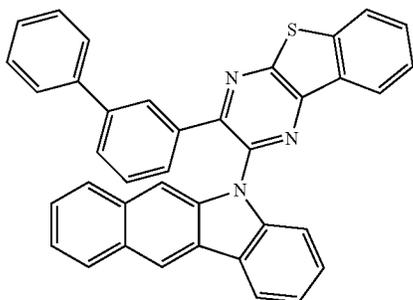
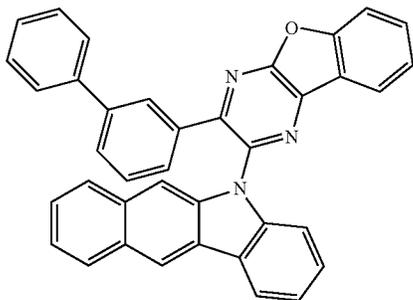
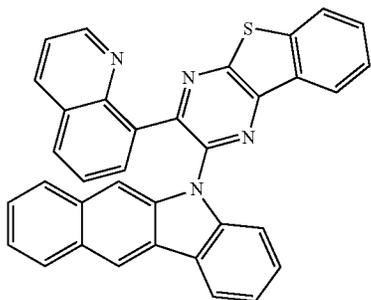
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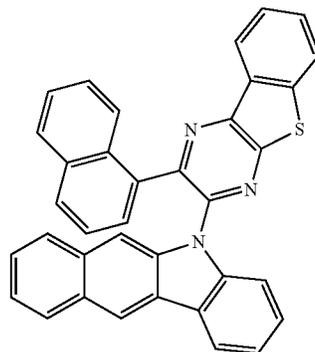
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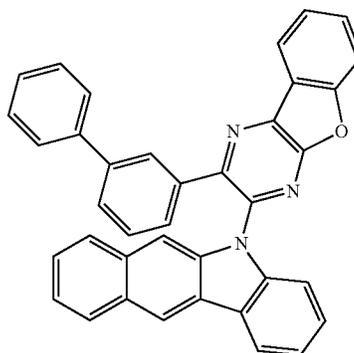
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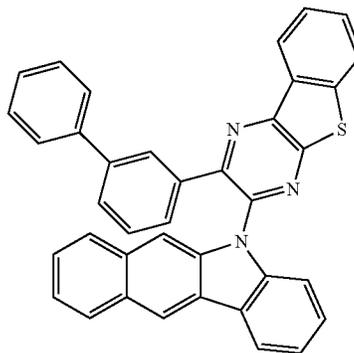
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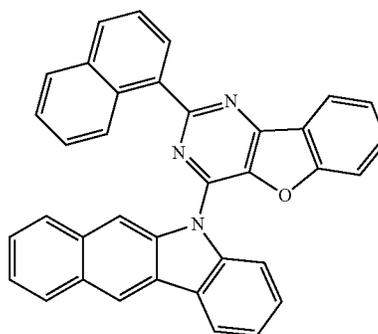
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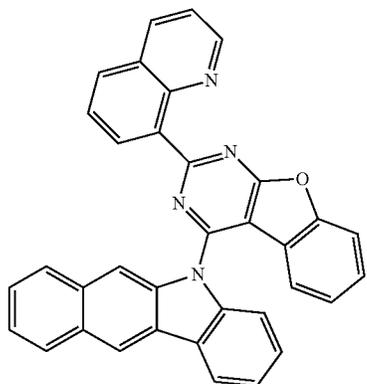
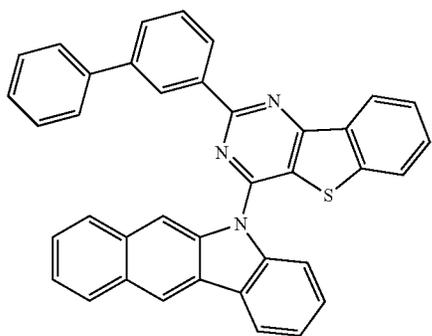
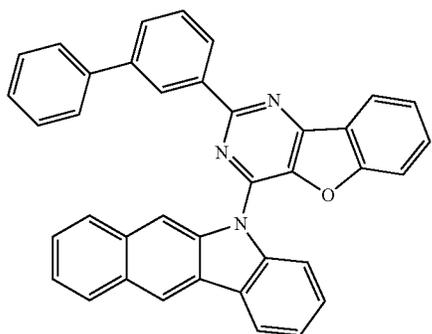
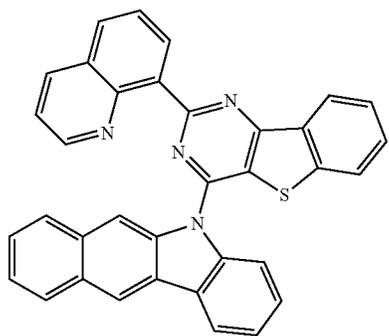
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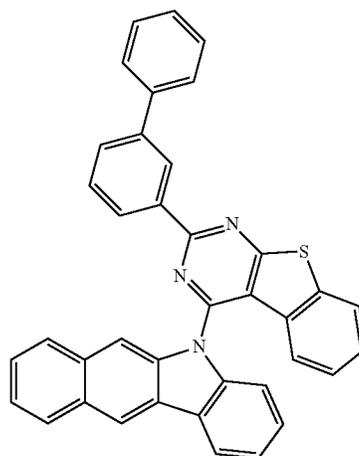
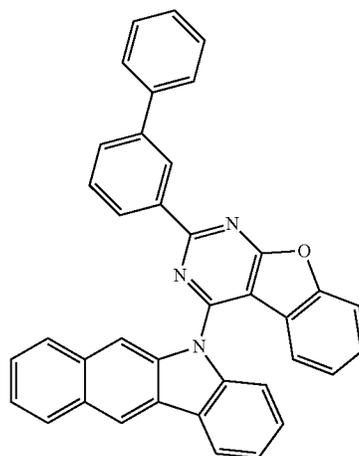
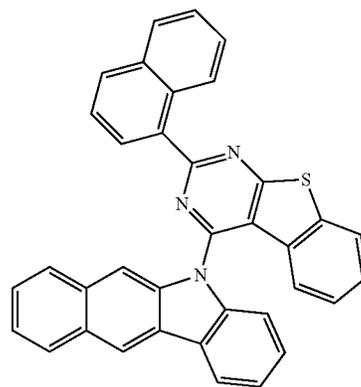


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**516**  
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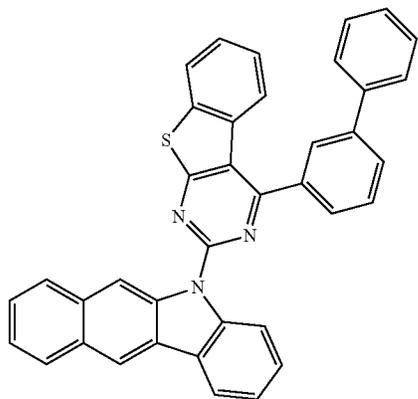
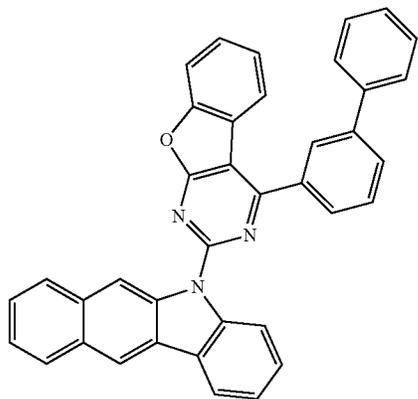
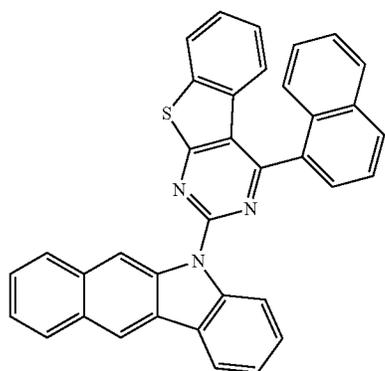
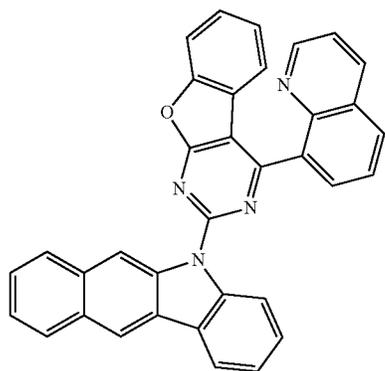
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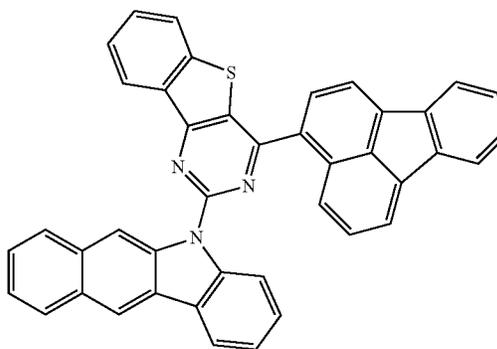
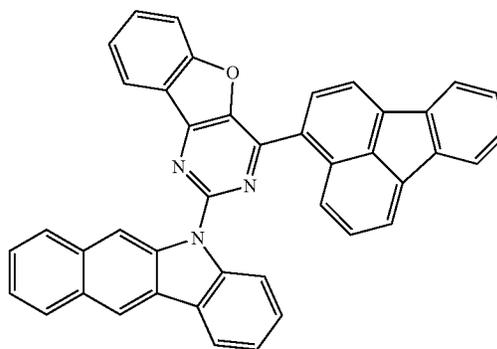
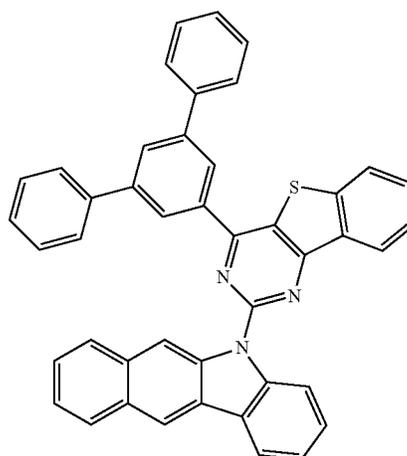
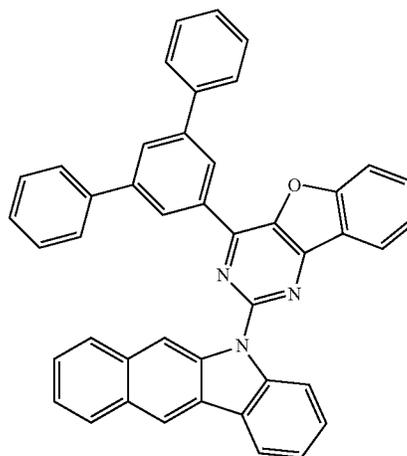
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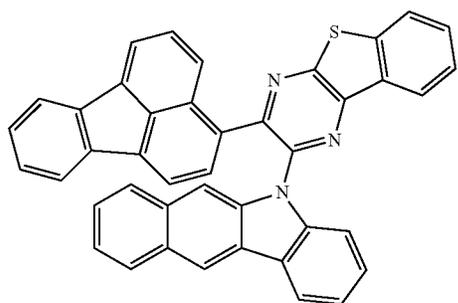
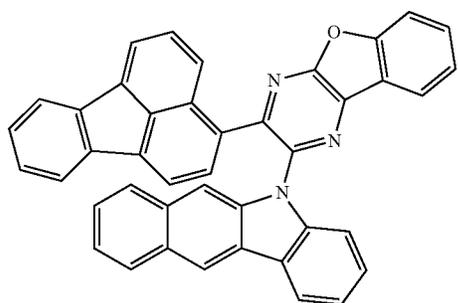
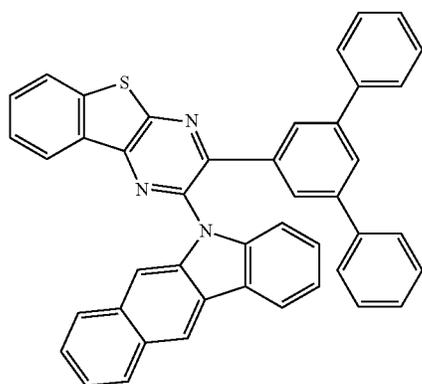
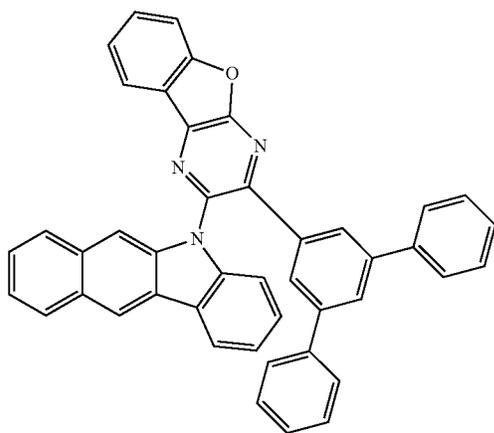
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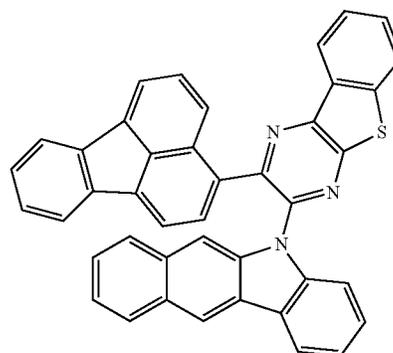
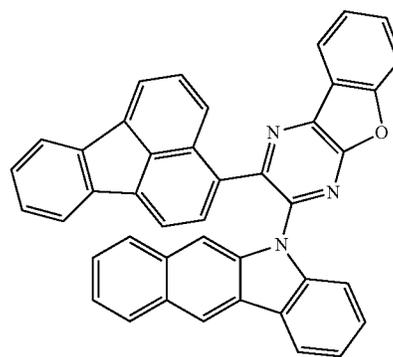
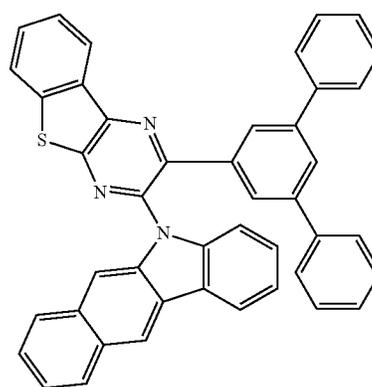
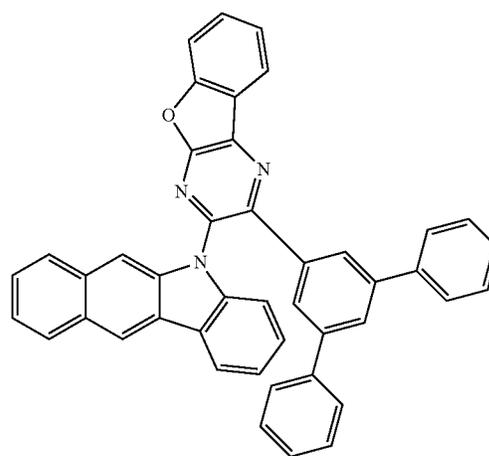
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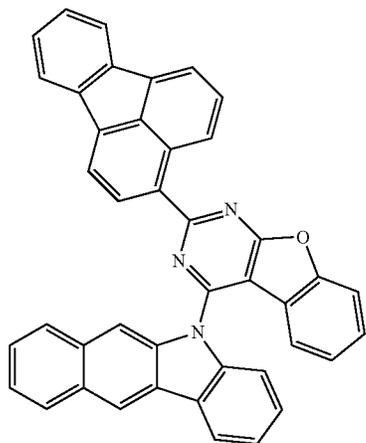
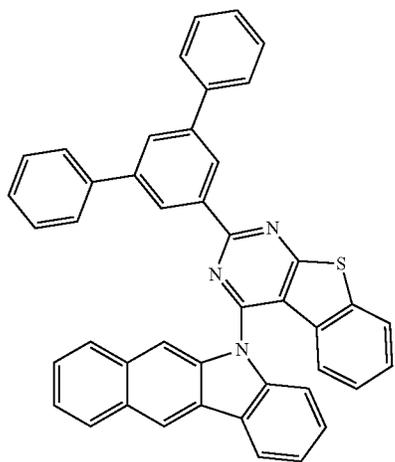
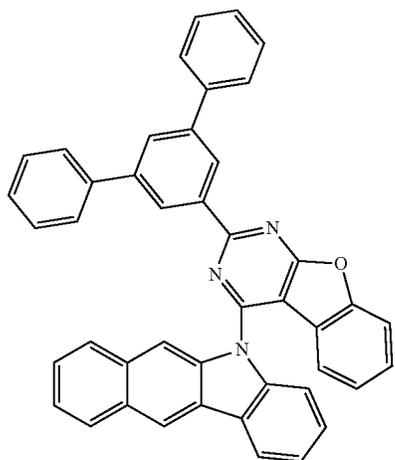
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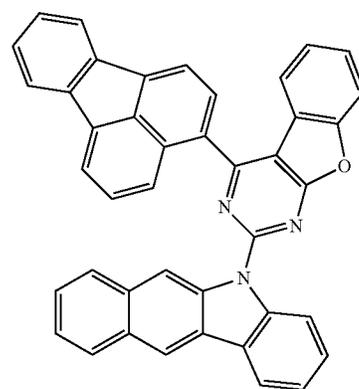
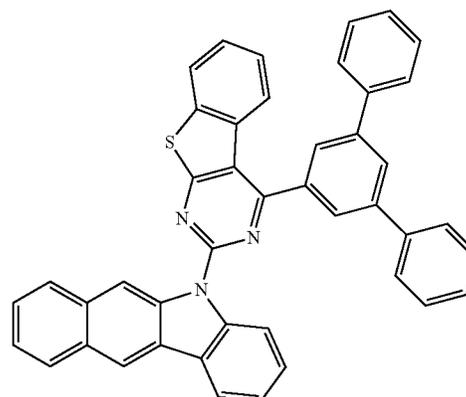
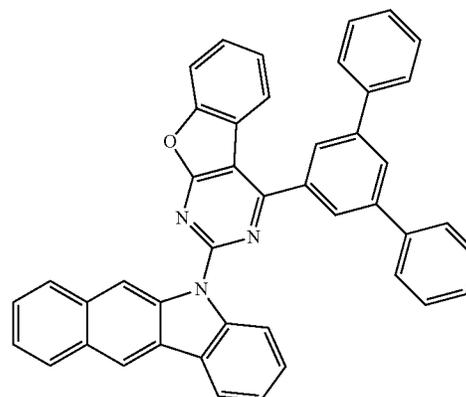
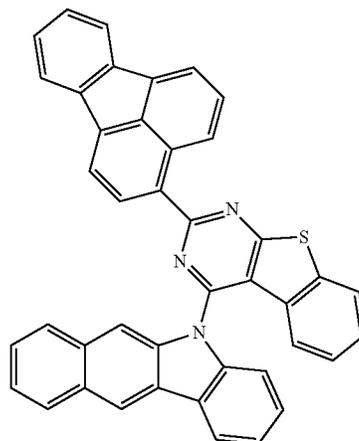
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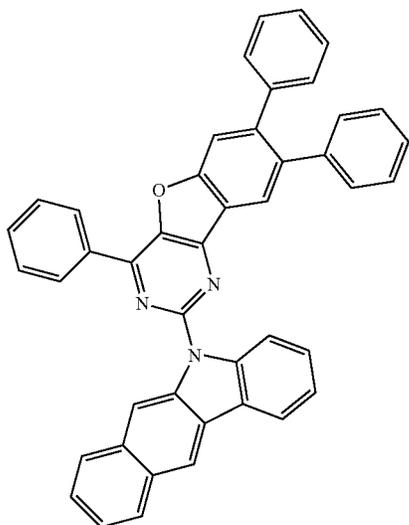
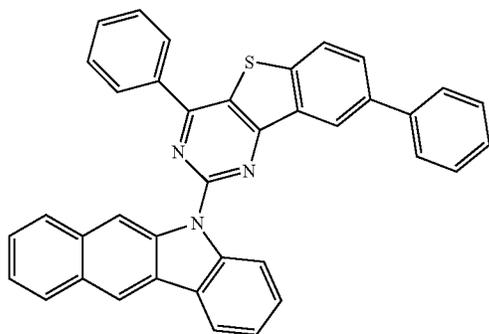
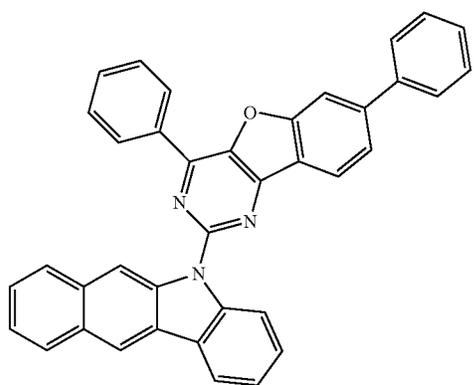
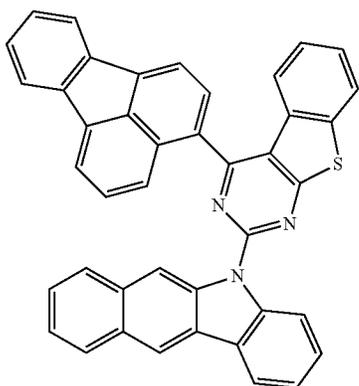
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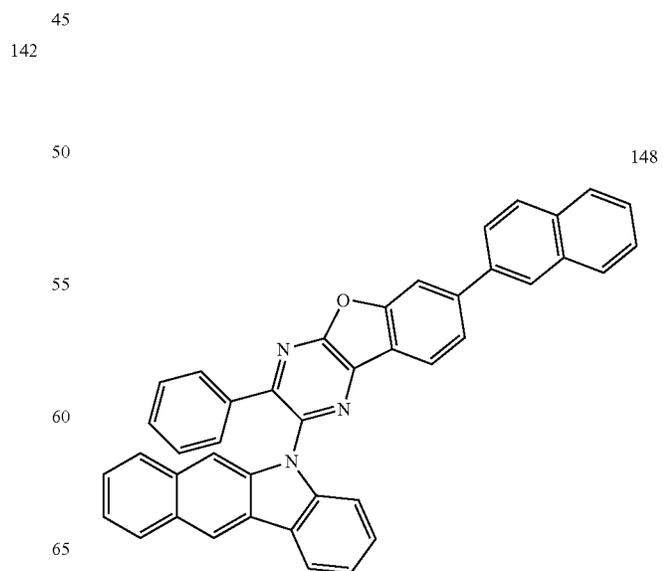
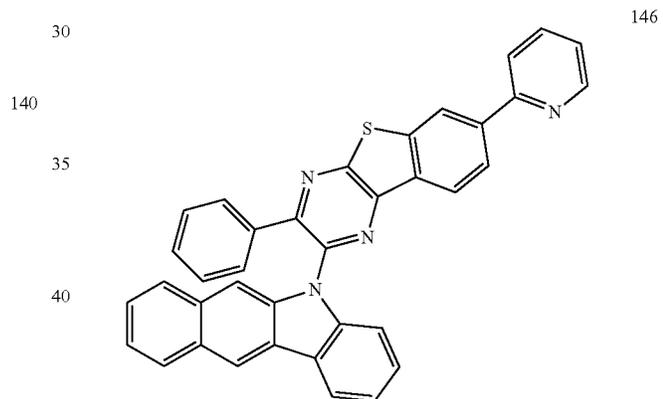
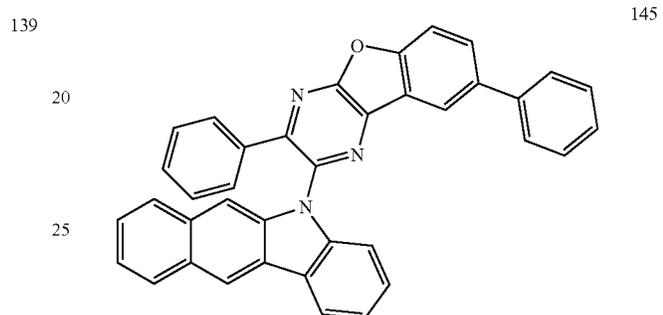
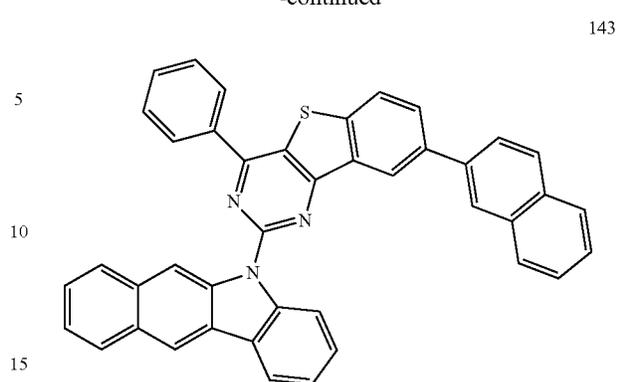
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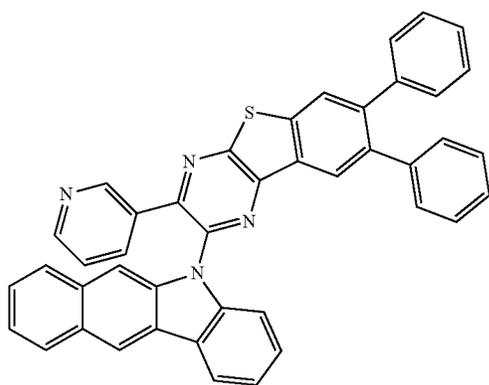
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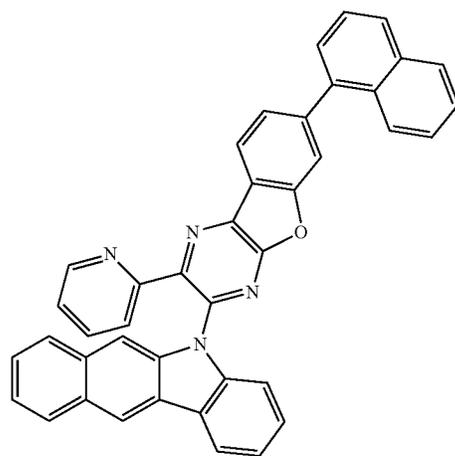
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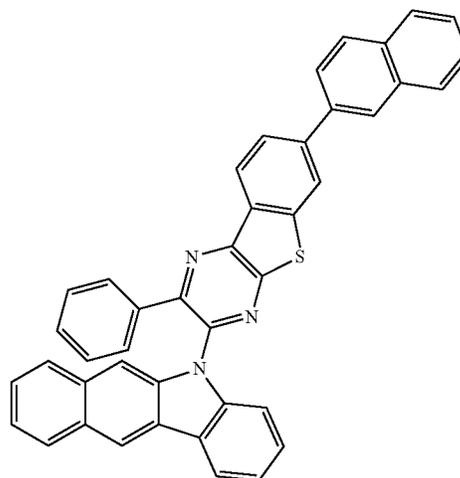
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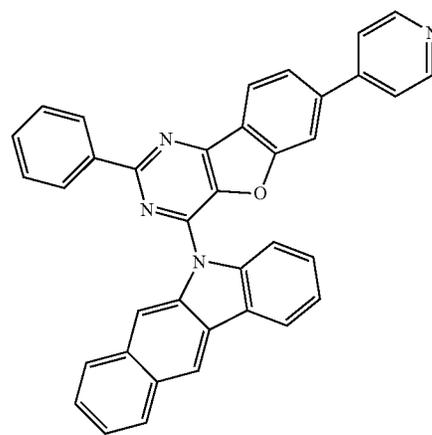
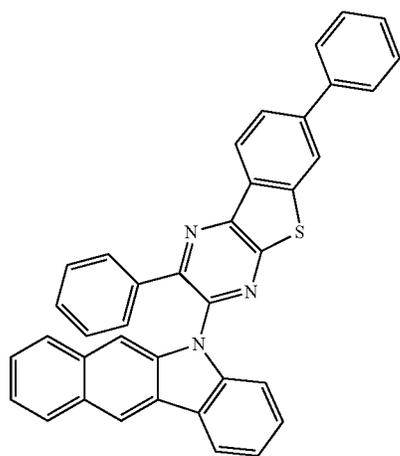
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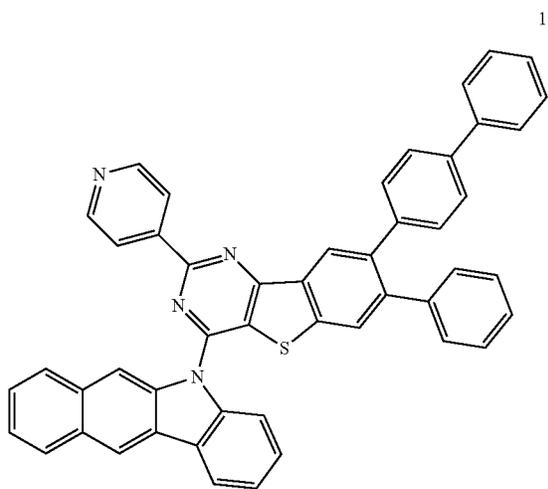
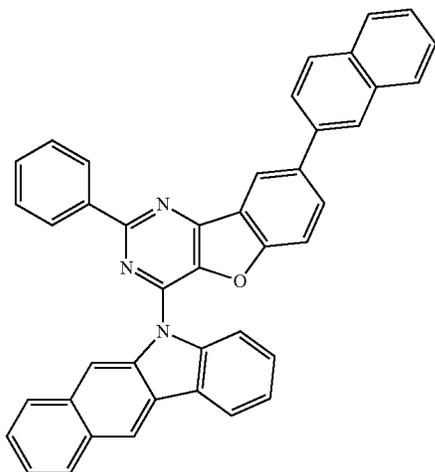
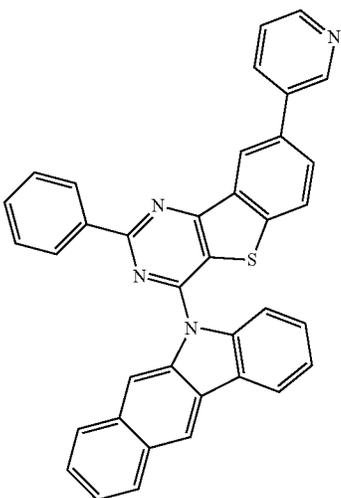
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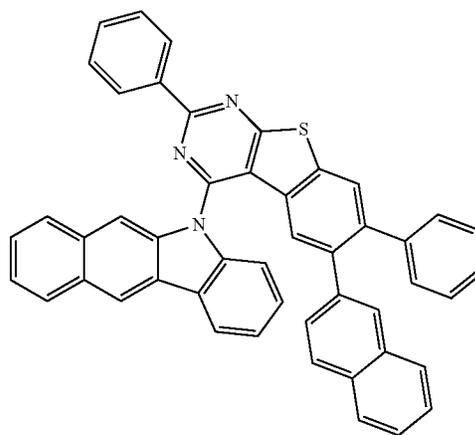
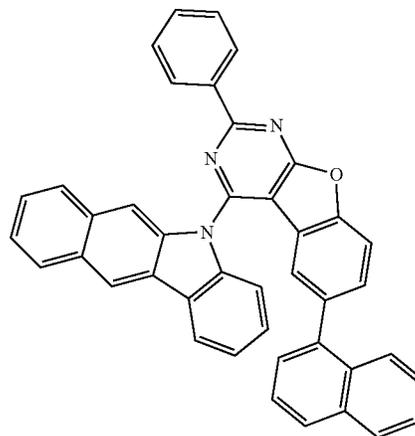
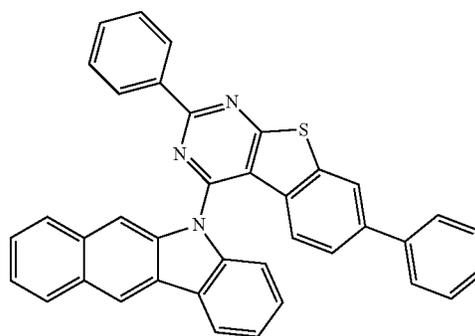
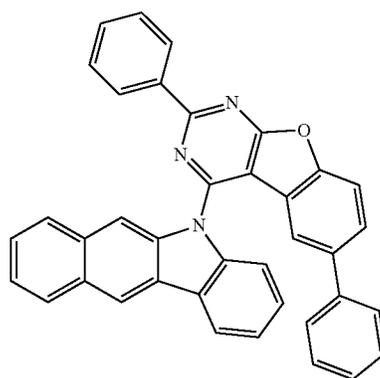
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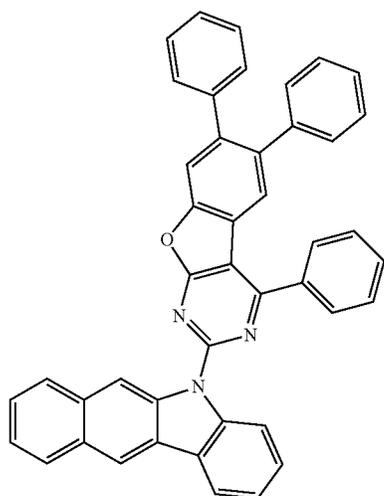
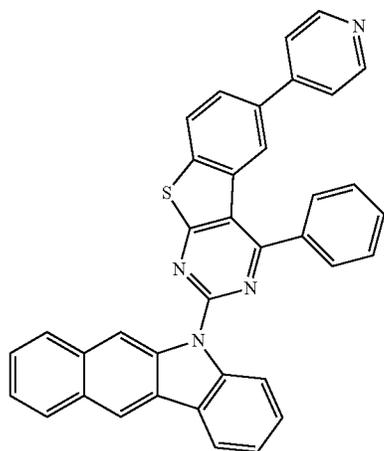
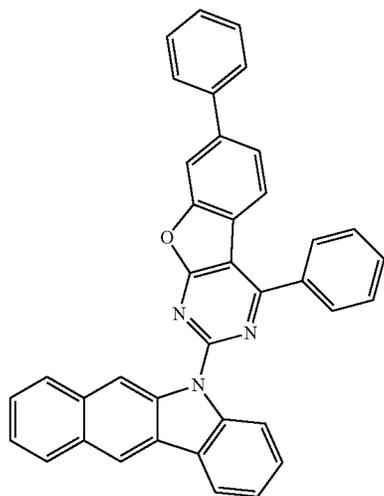
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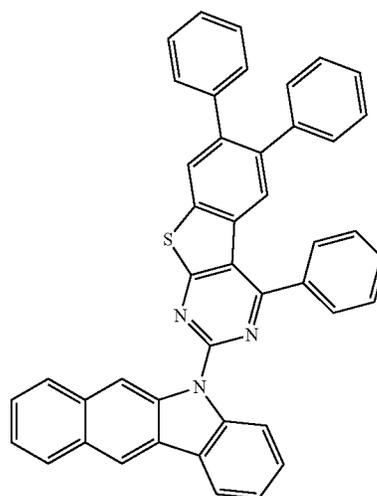
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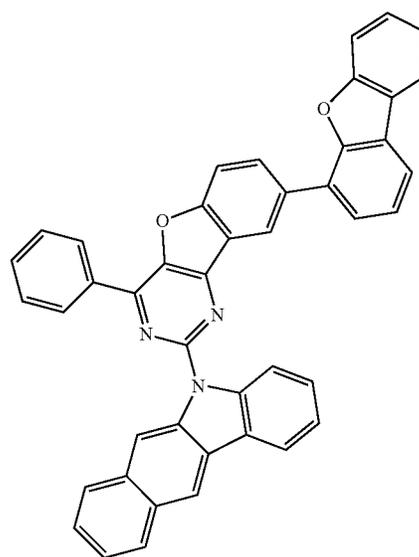
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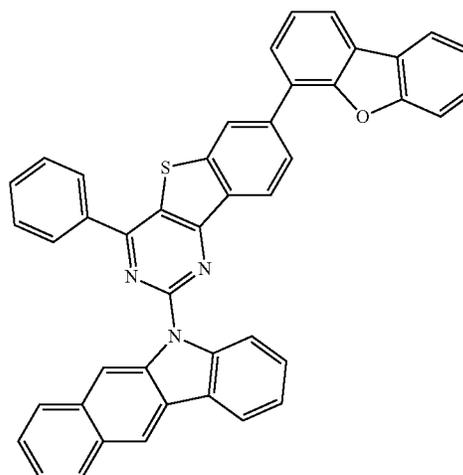
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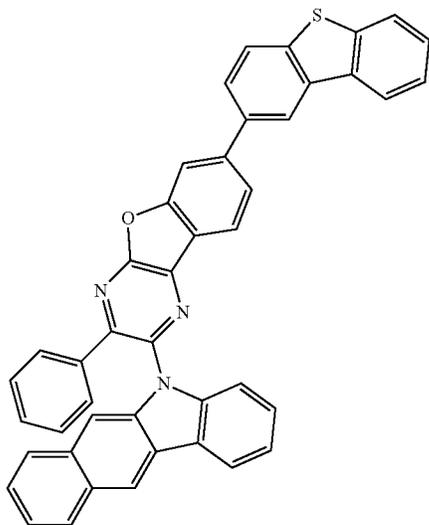
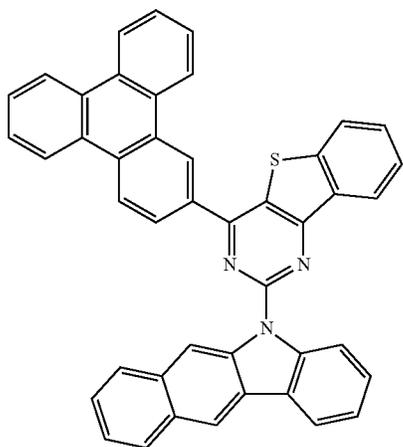
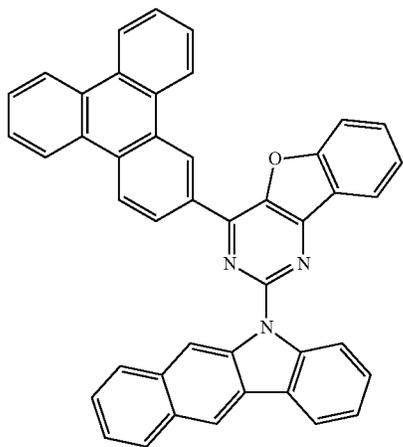
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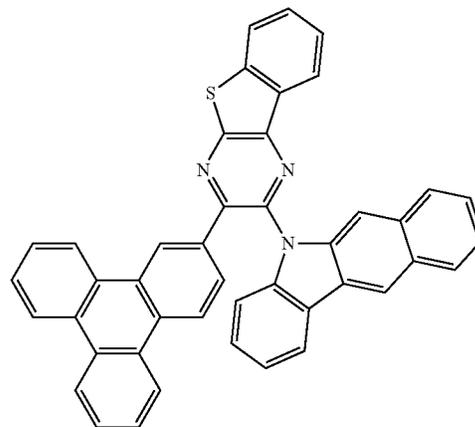
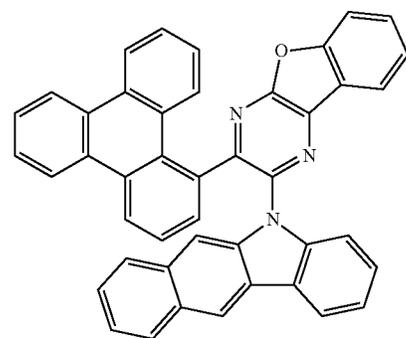
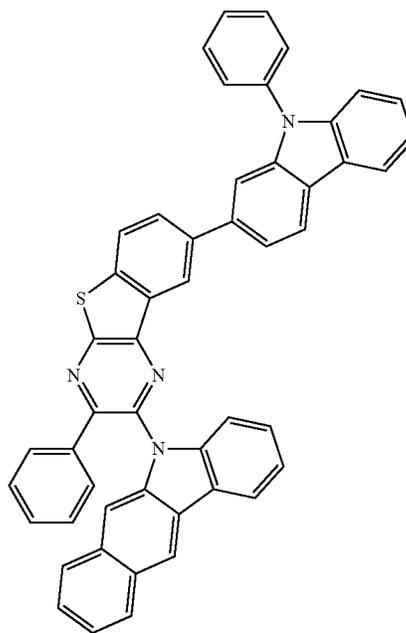
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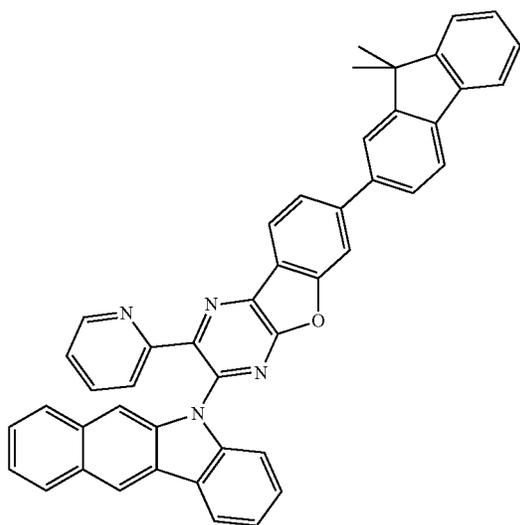
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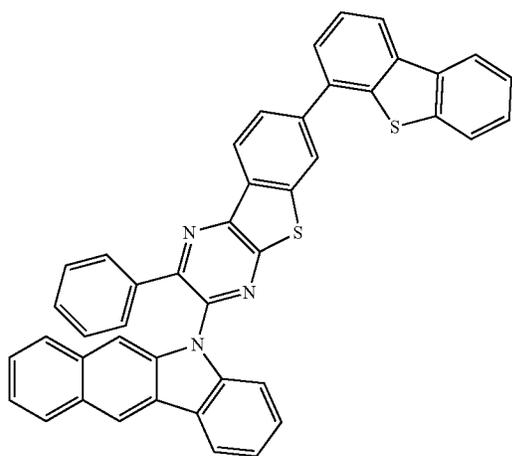
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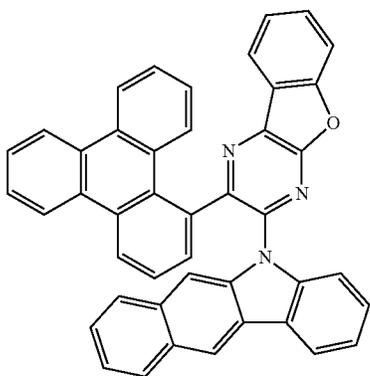
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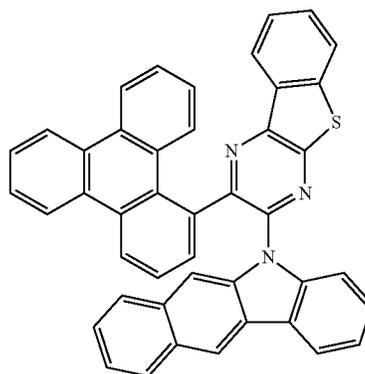
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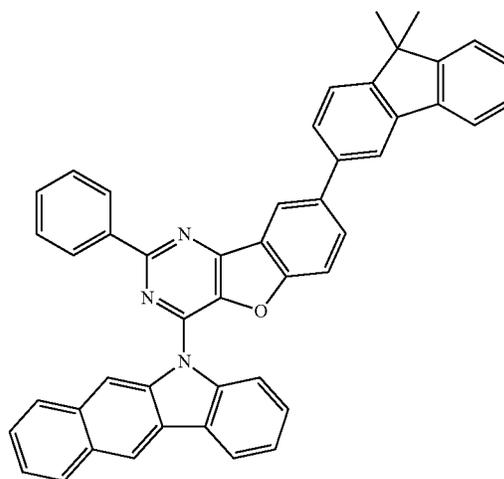
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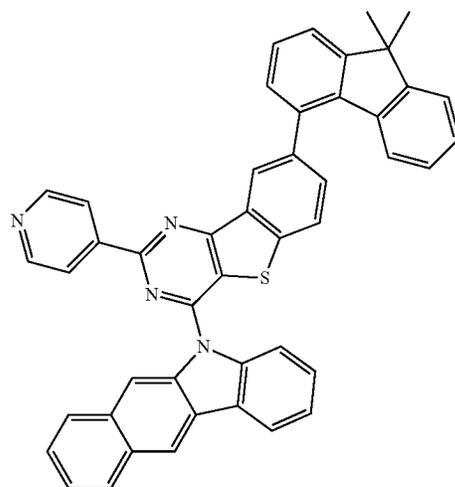
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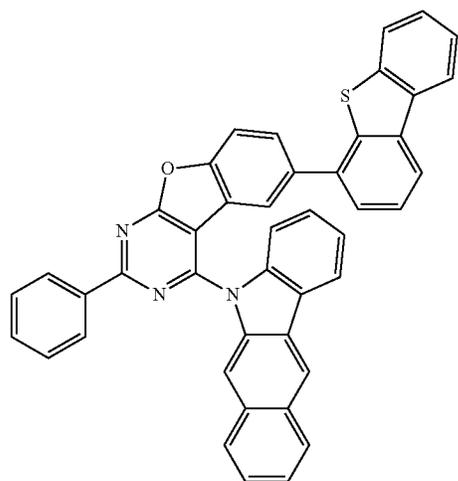
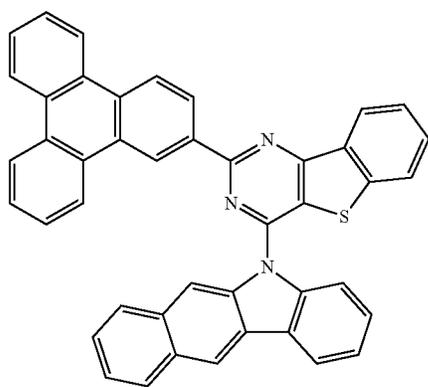
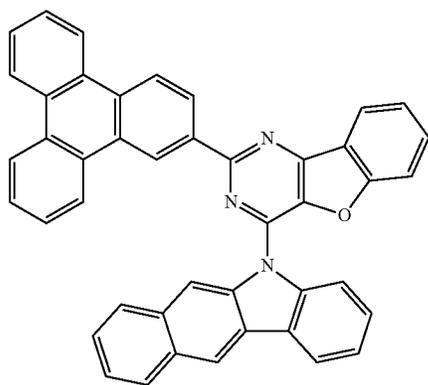
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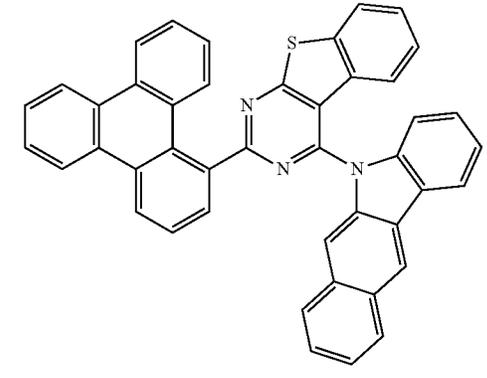
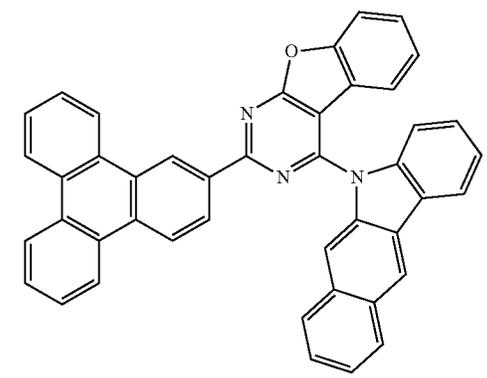
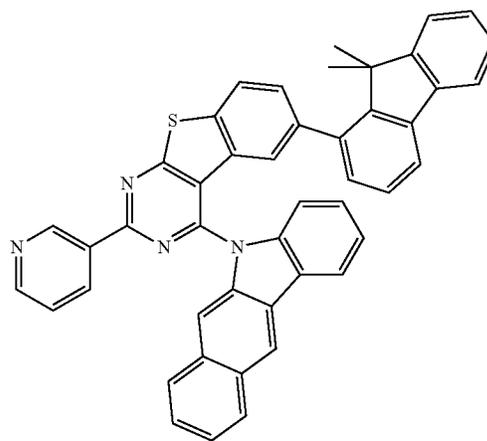
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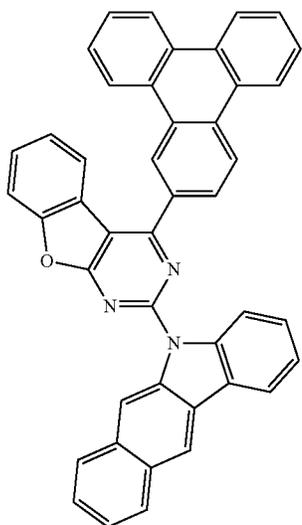
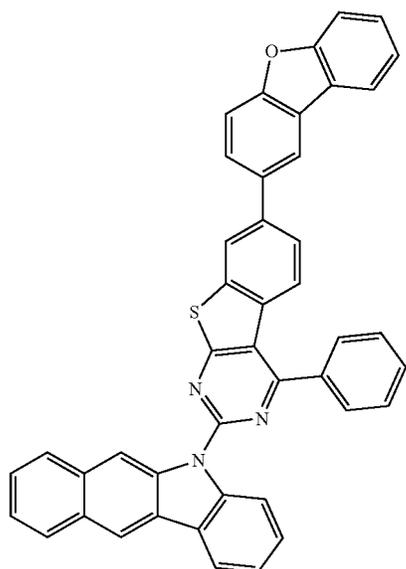
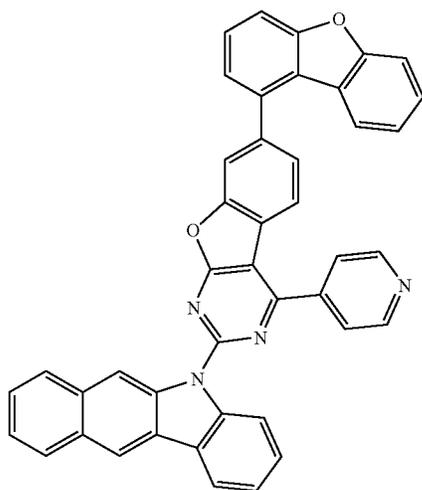


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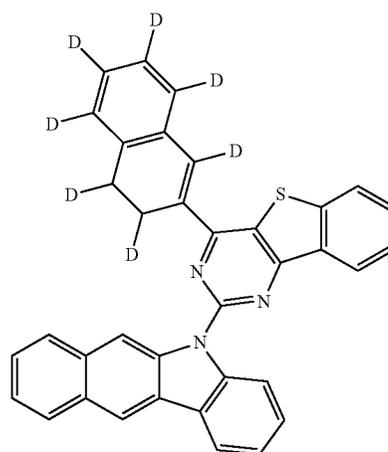
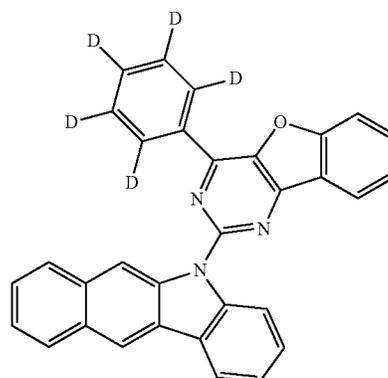
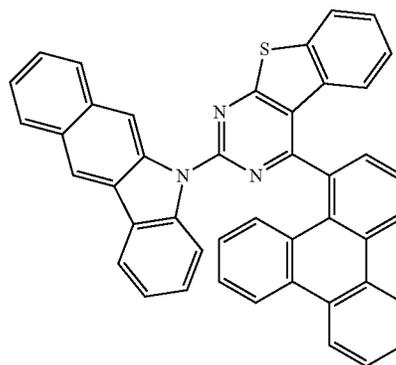
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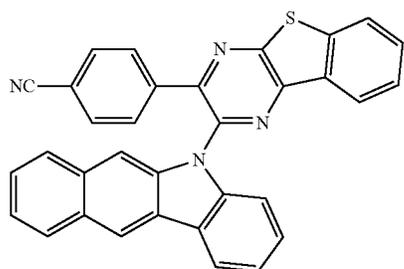
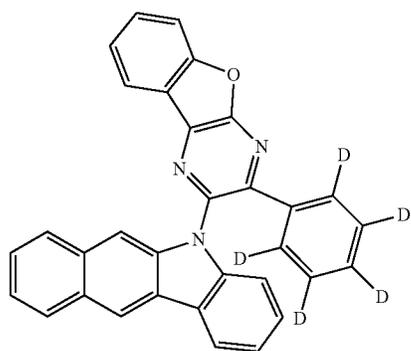
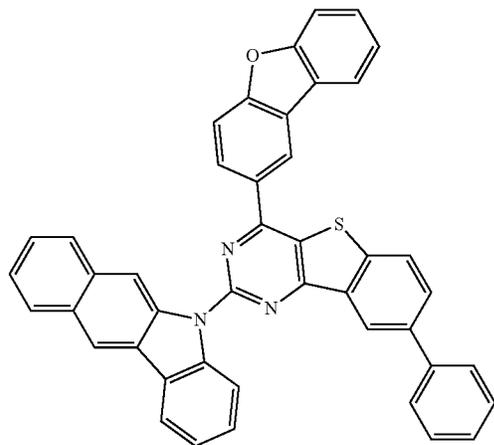
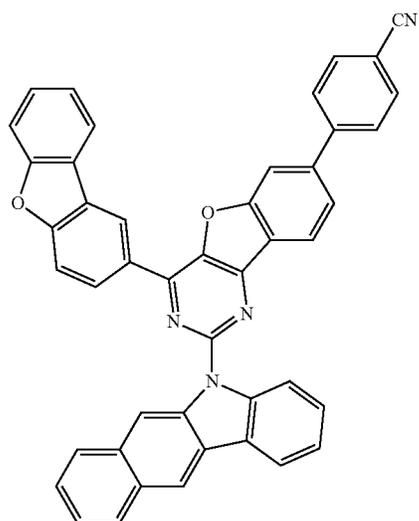
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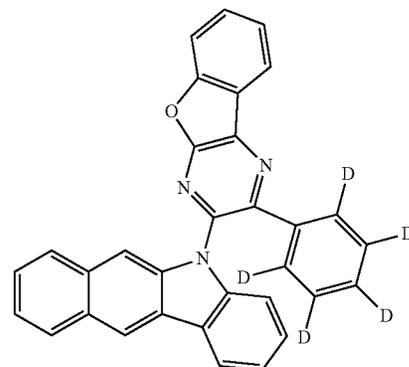
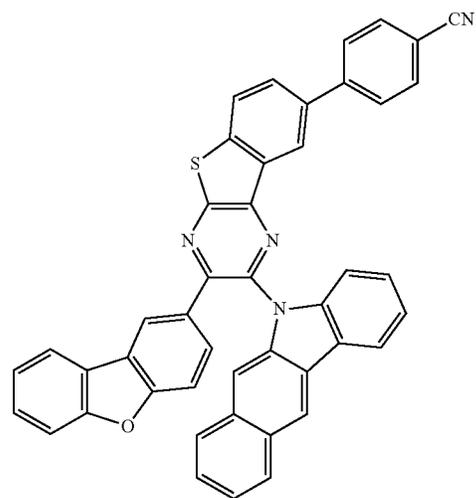
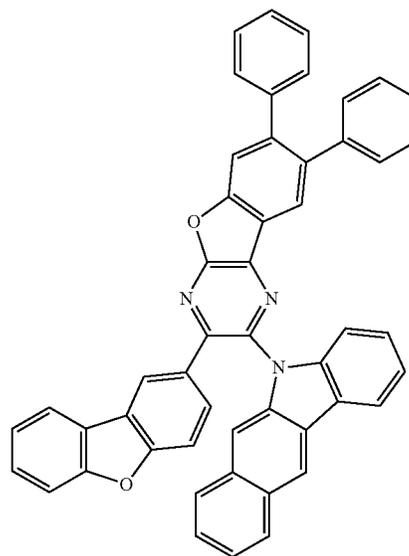
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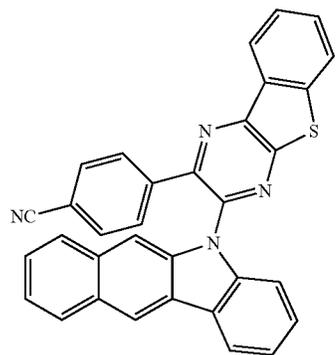
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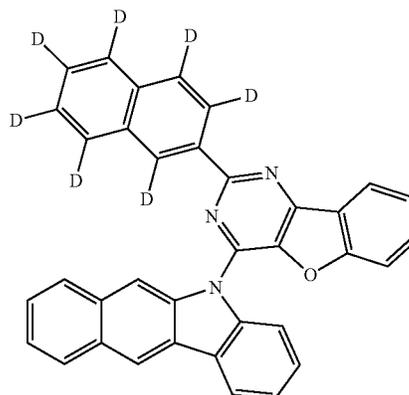
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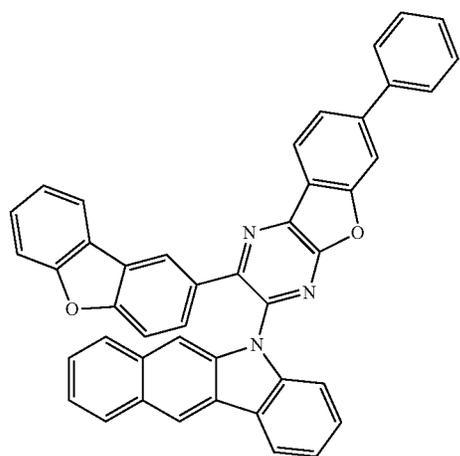
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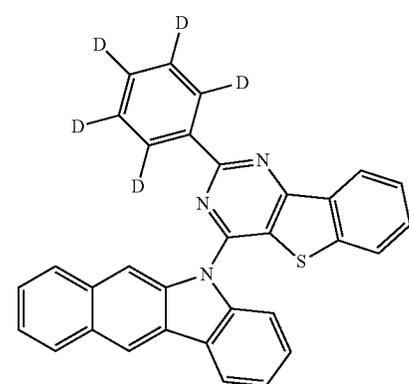
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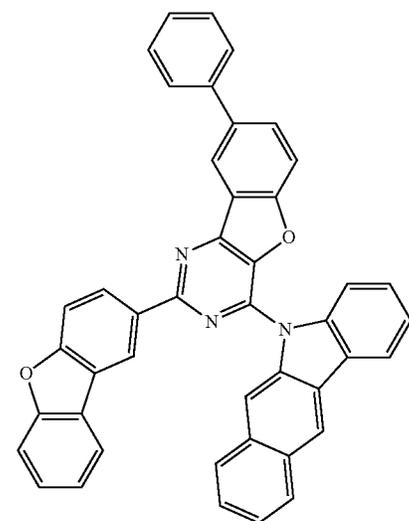
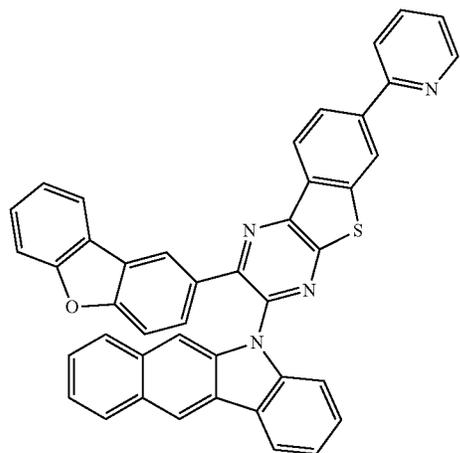
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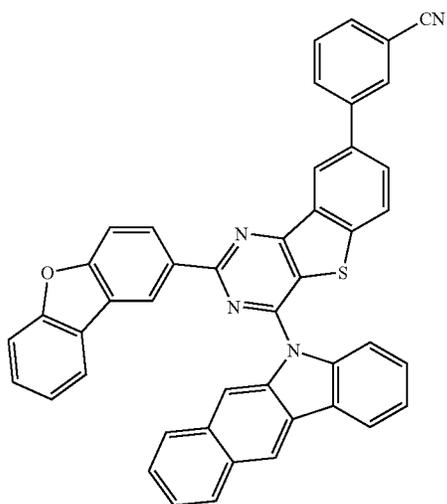
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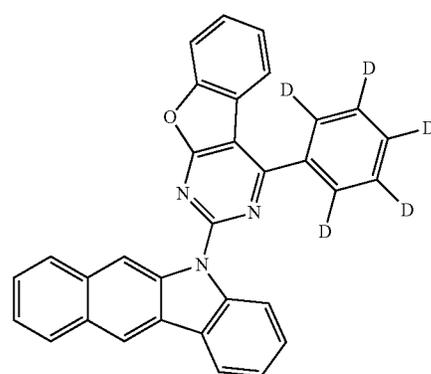
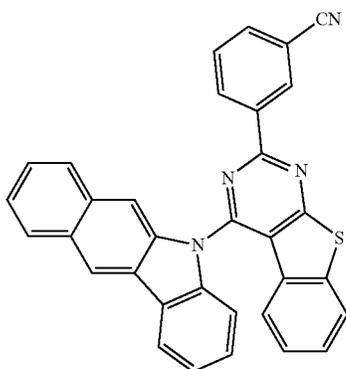
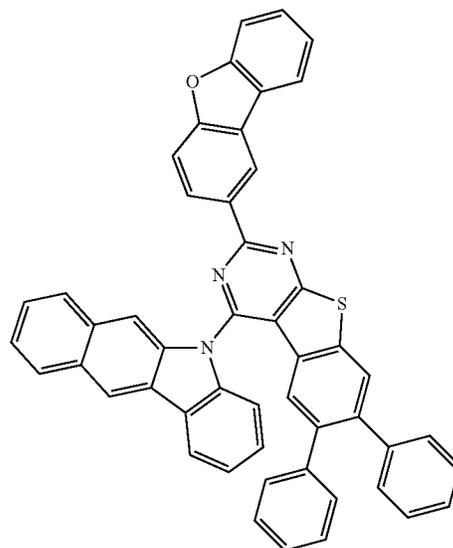
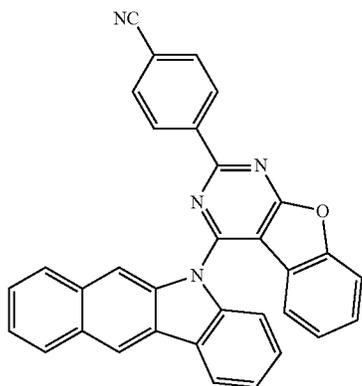
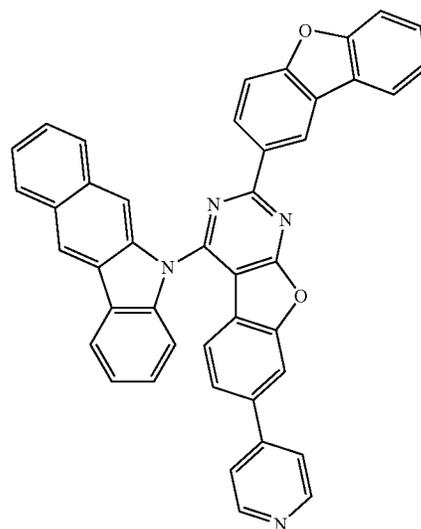
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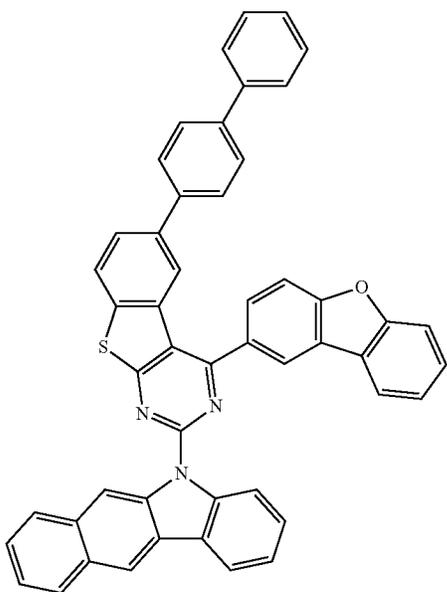
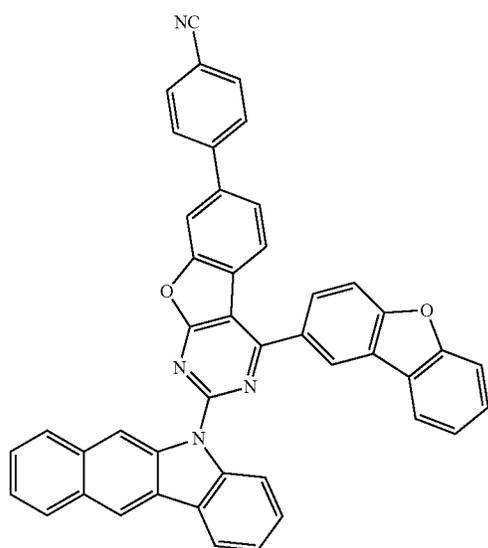
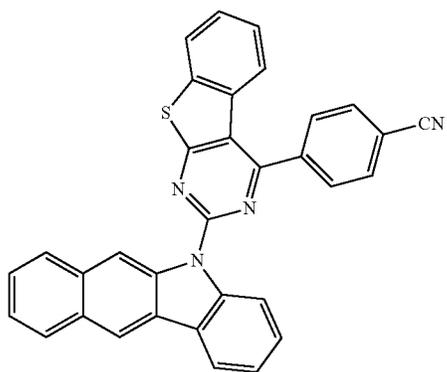
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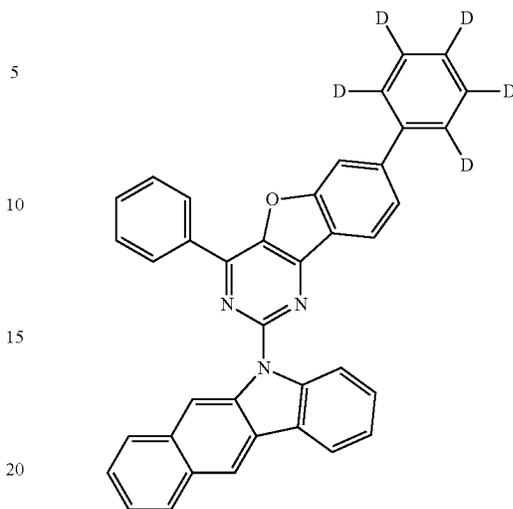


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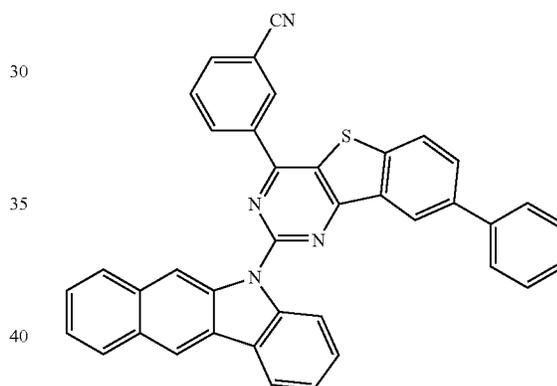
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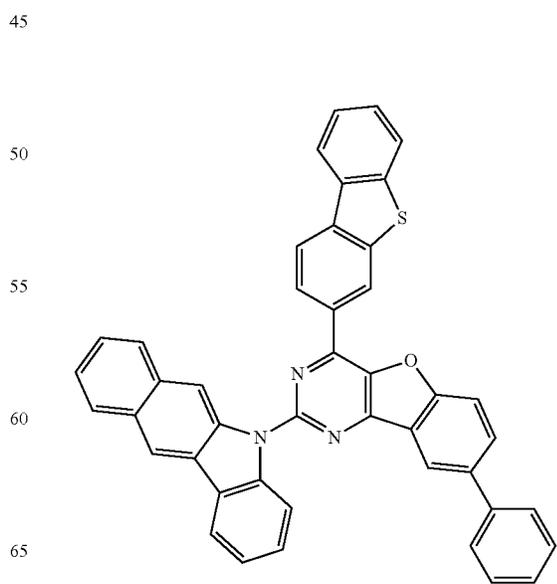
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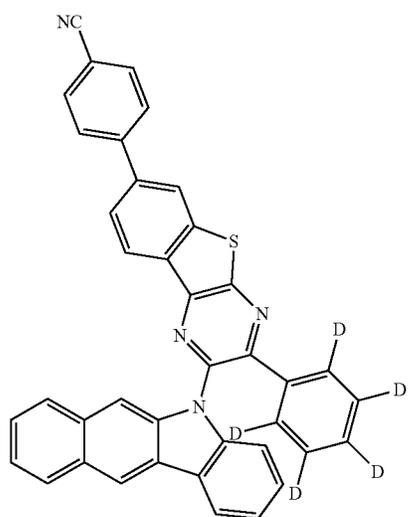
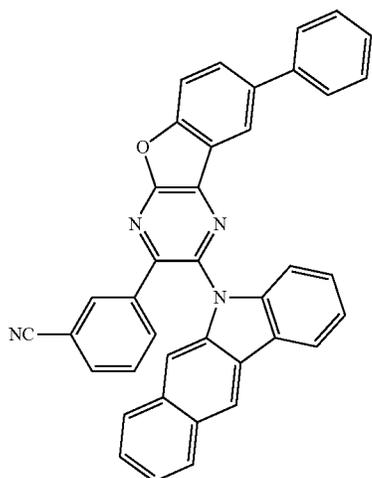
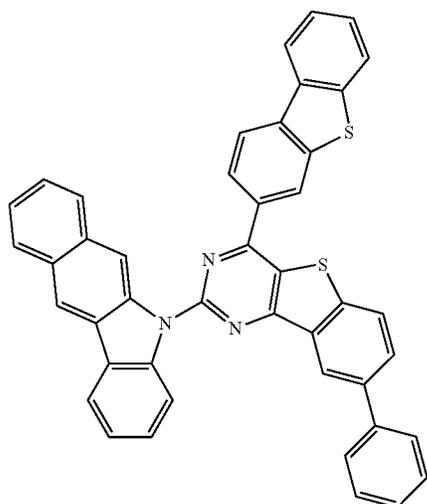


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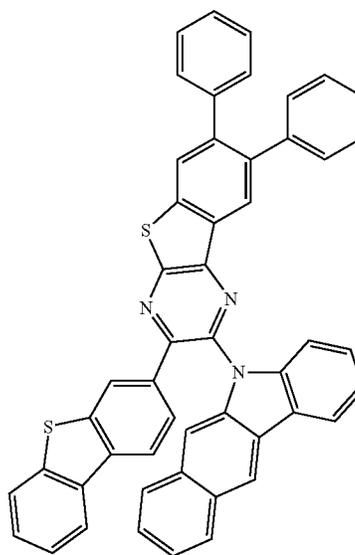
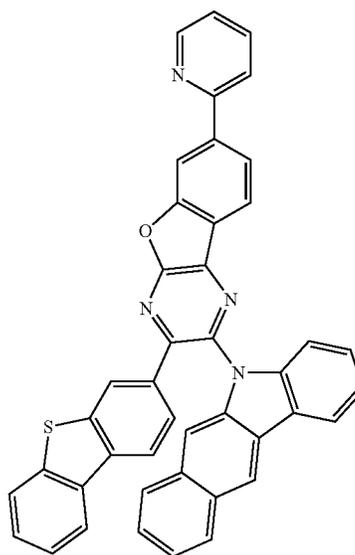
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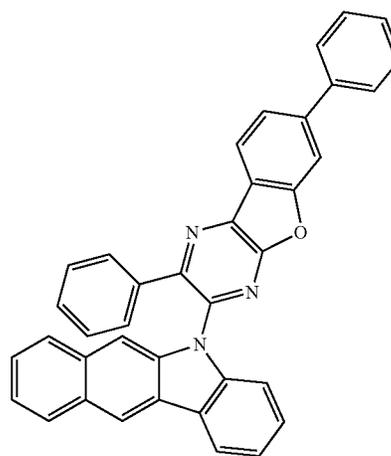
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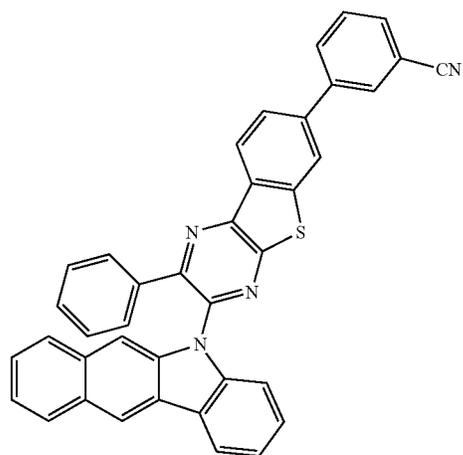
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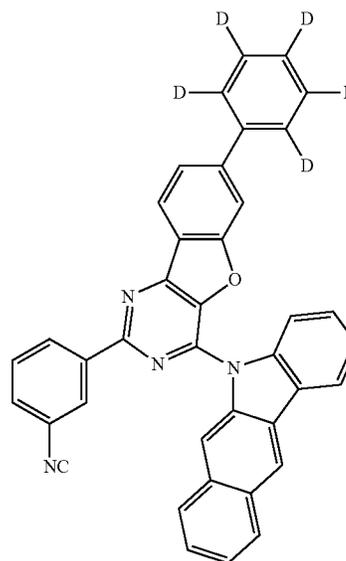
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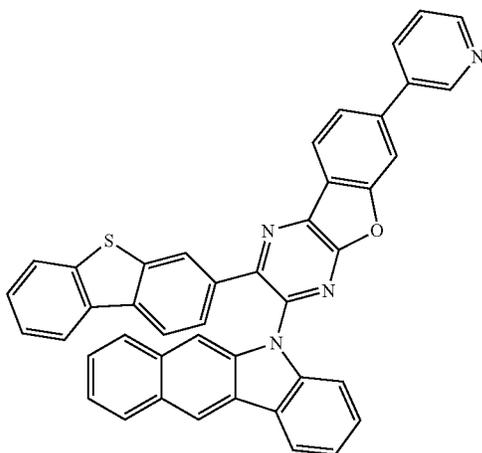
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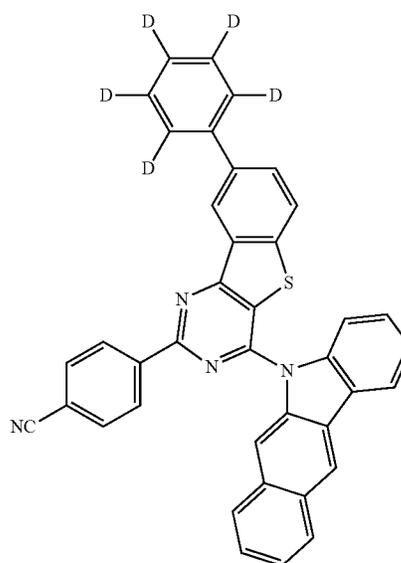
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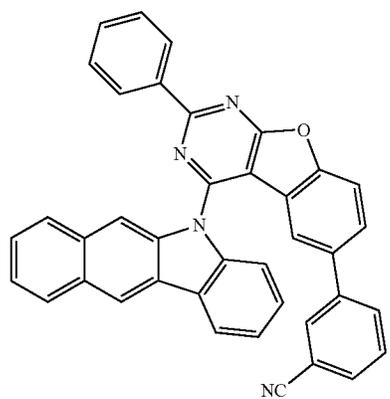
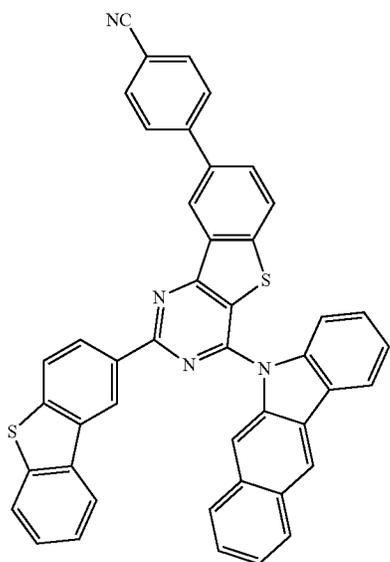
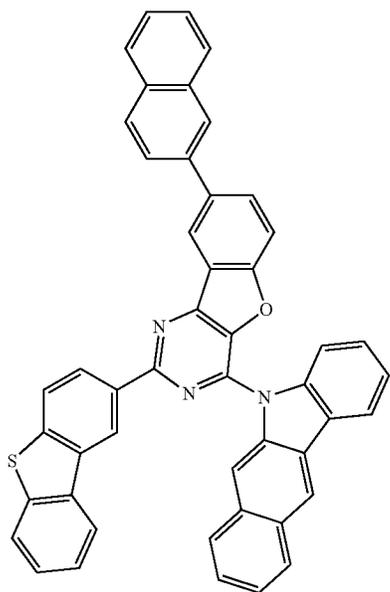
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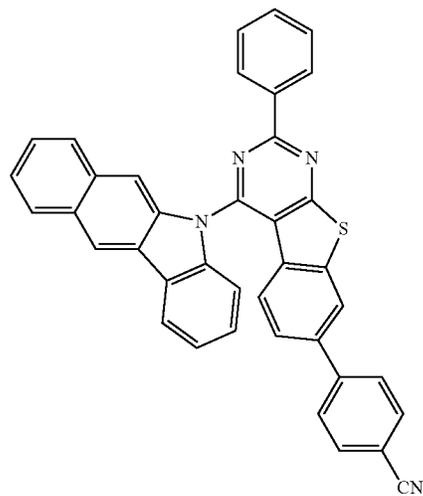
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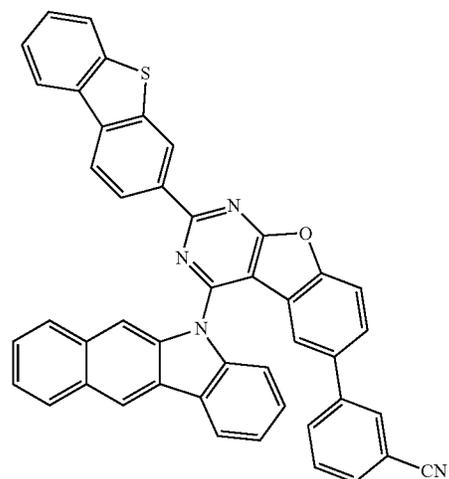
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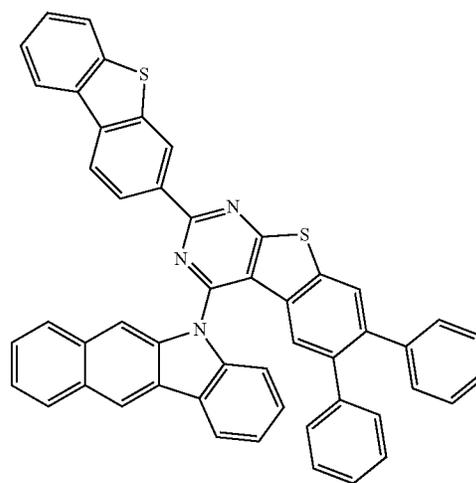
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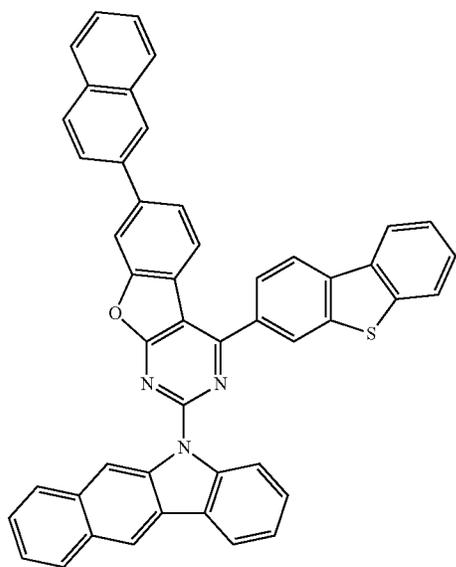
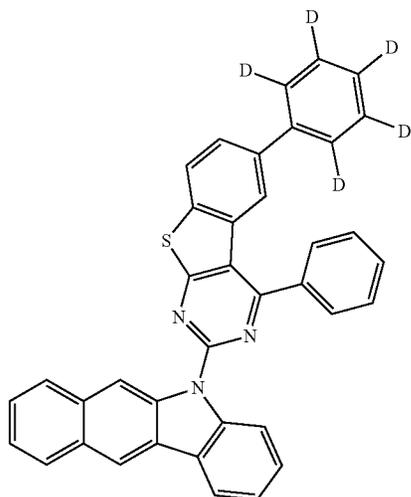
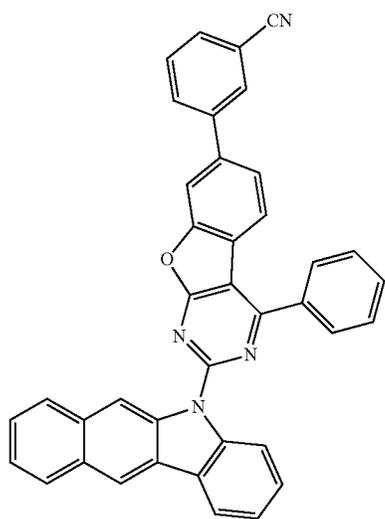
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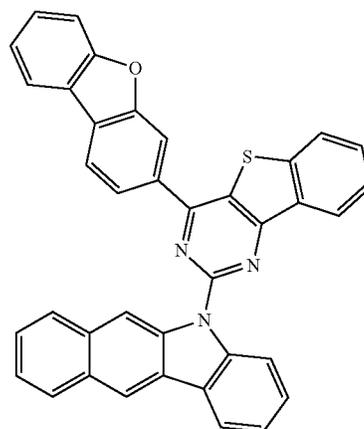
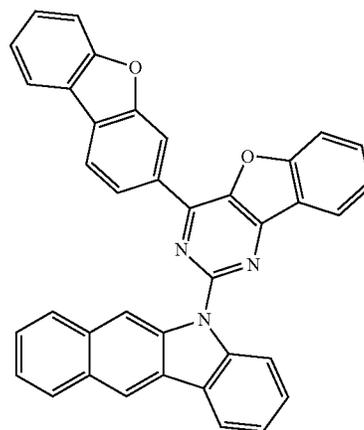
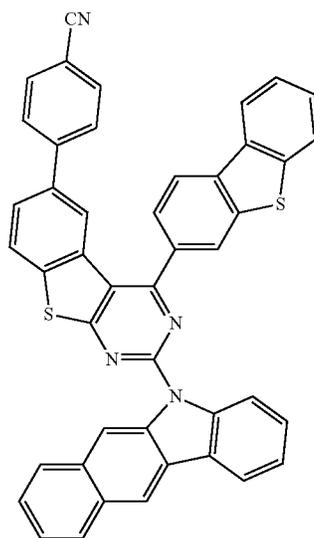
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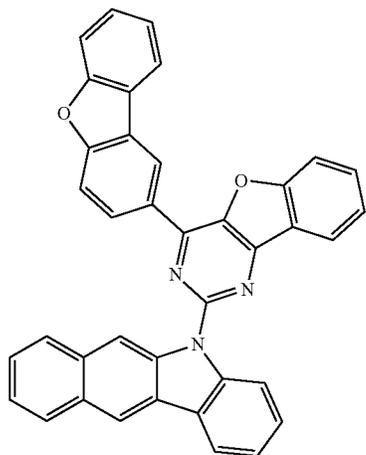
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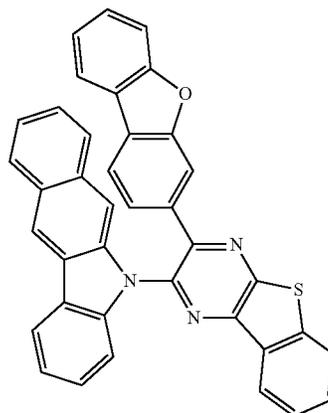
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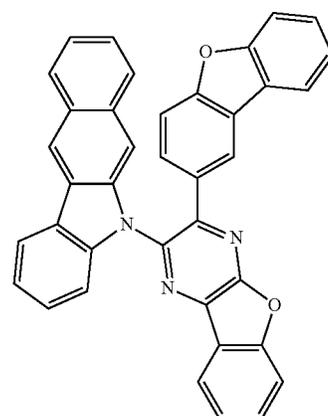
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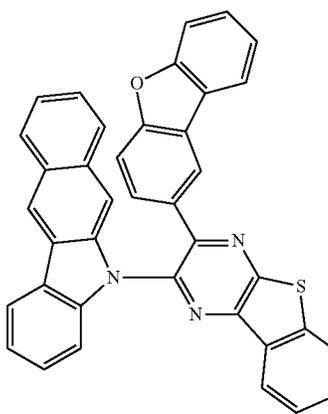
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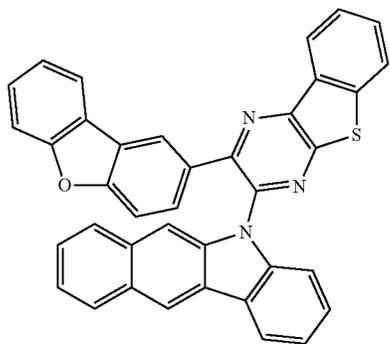
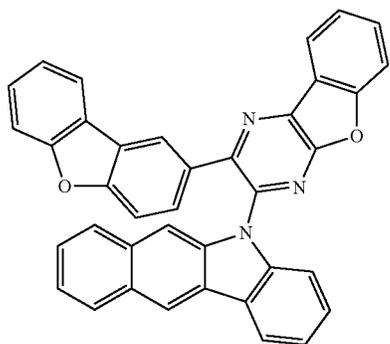
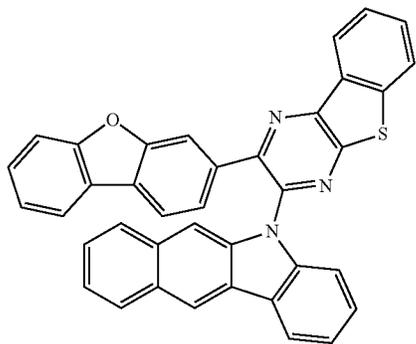
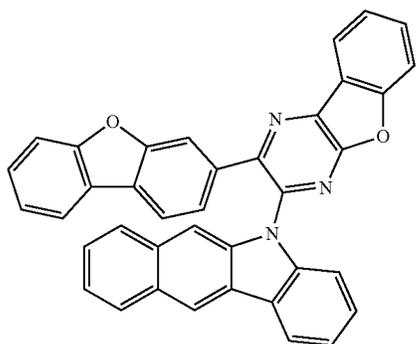
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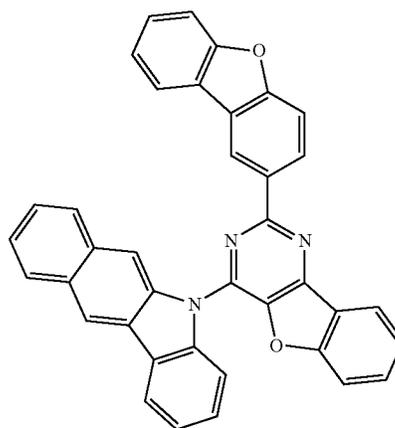
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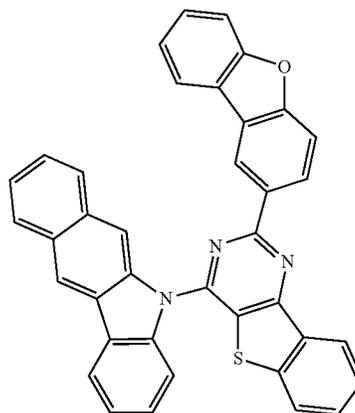
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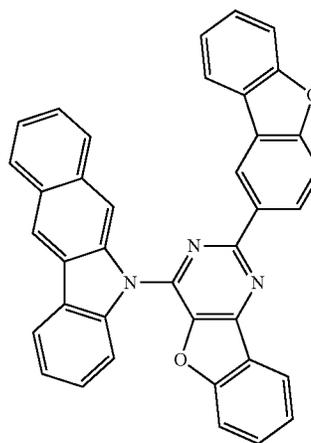
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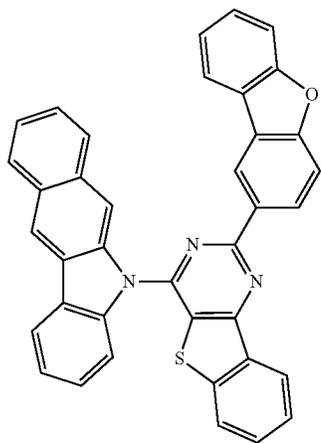
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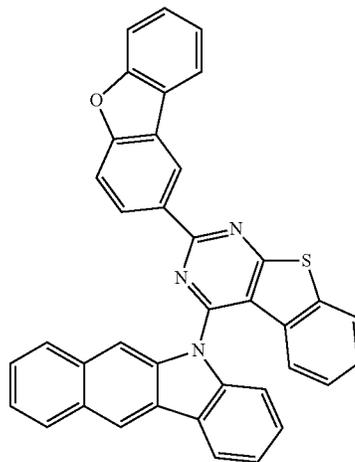
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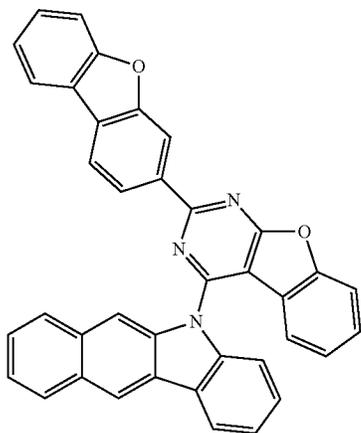
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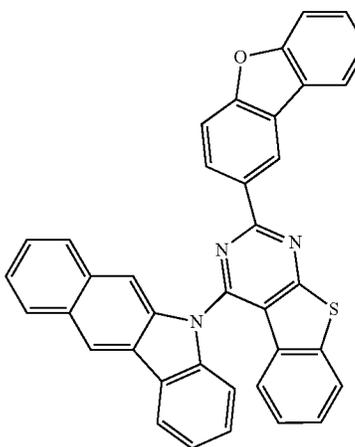


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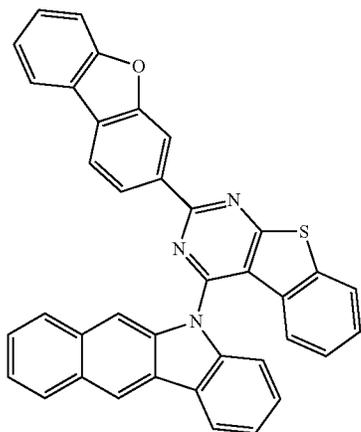
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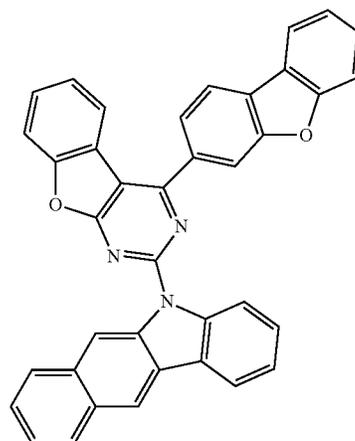
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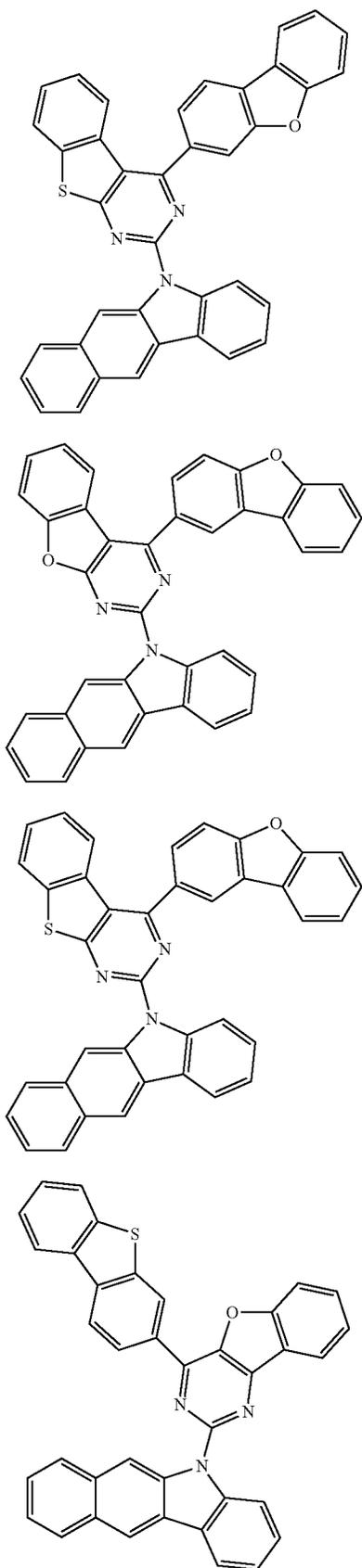
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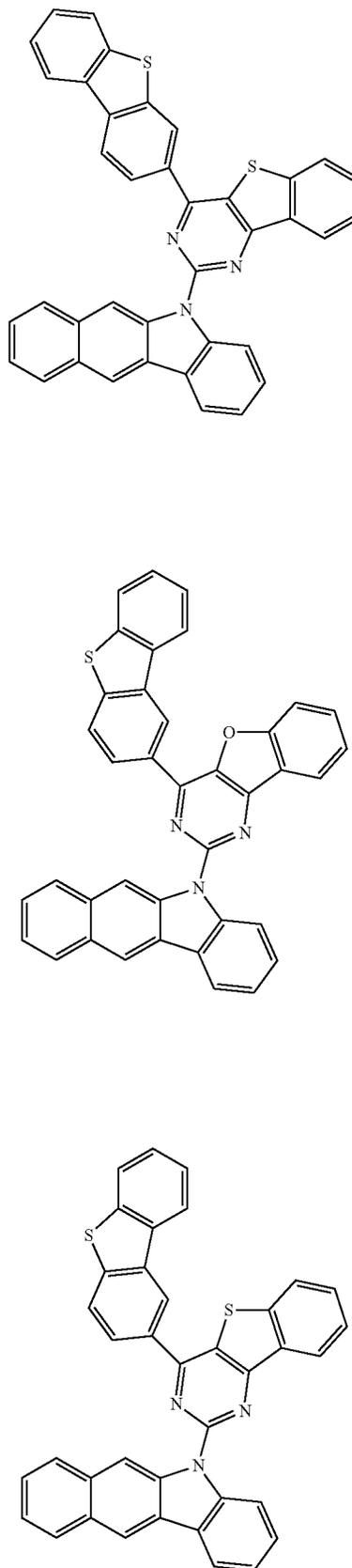
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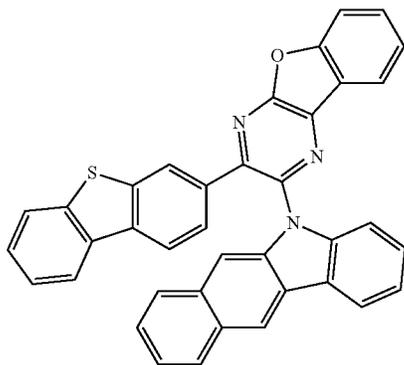


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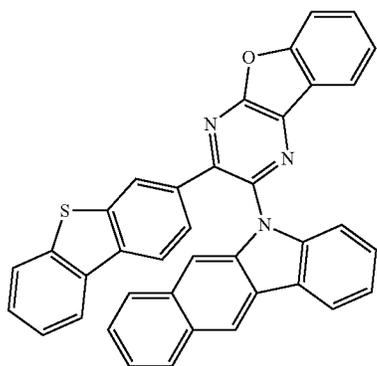


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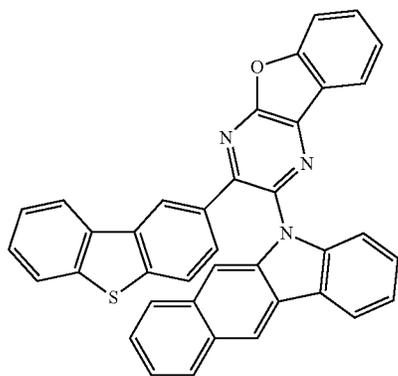


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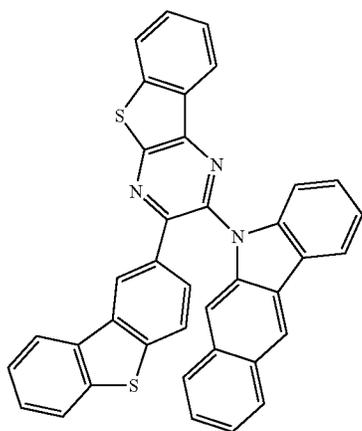


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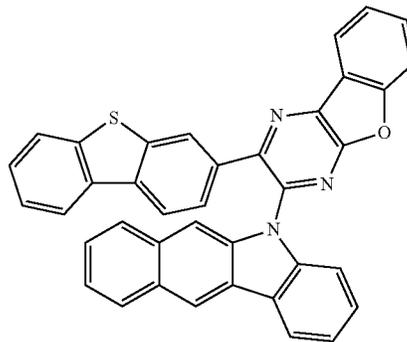
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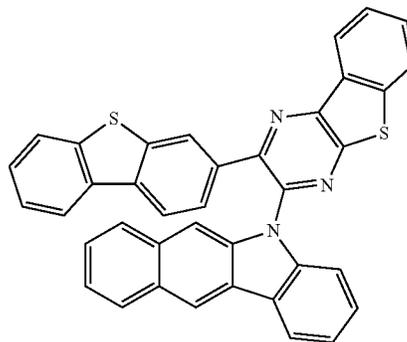
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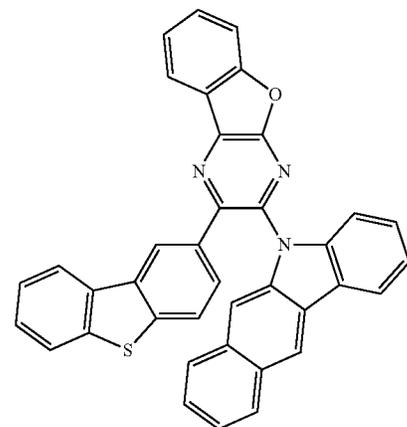
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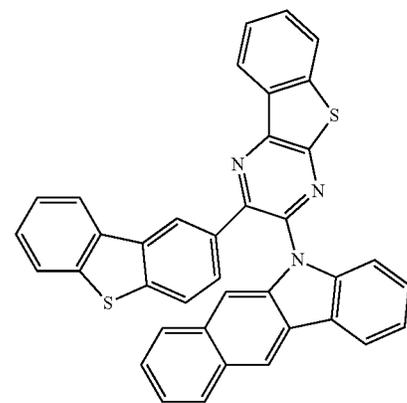
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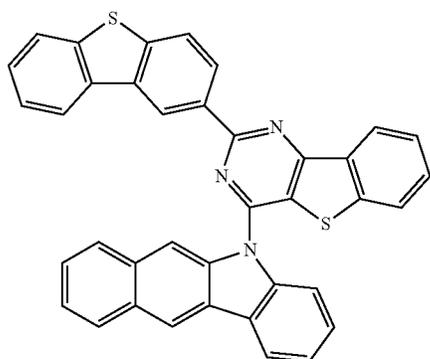
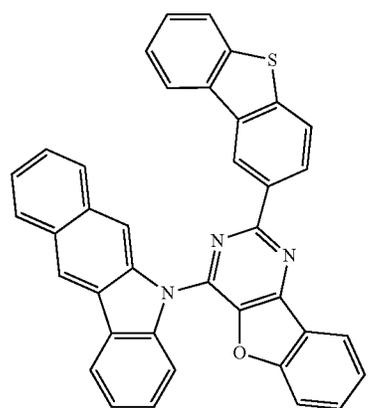
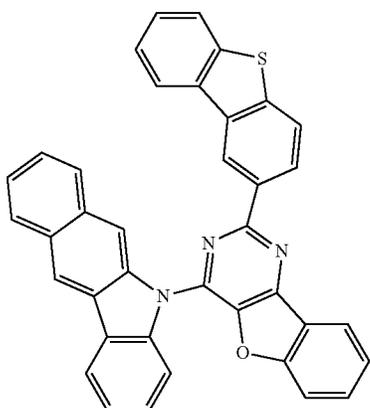
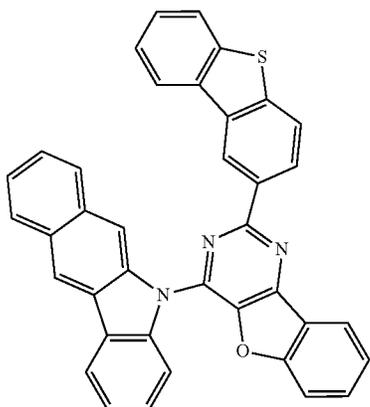
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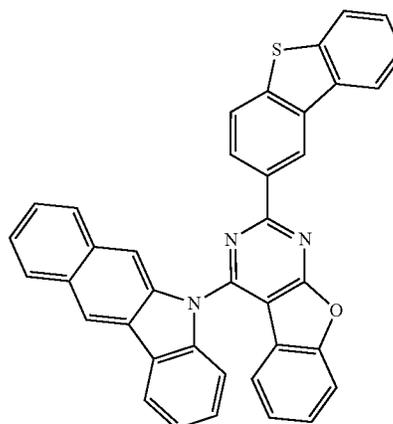
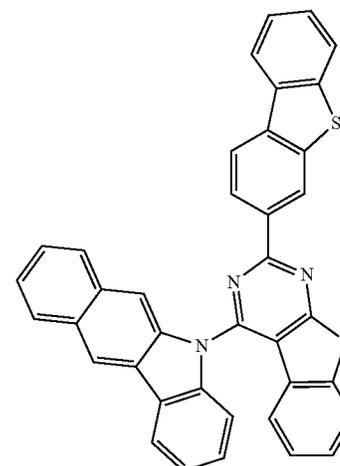
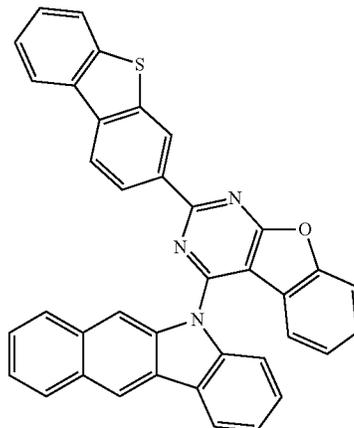
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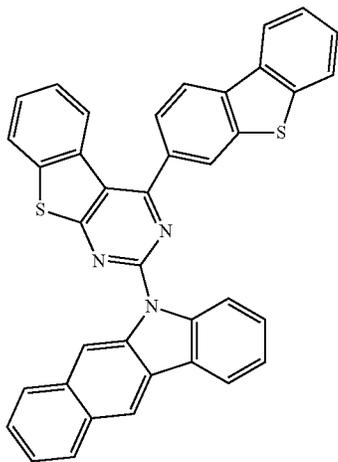
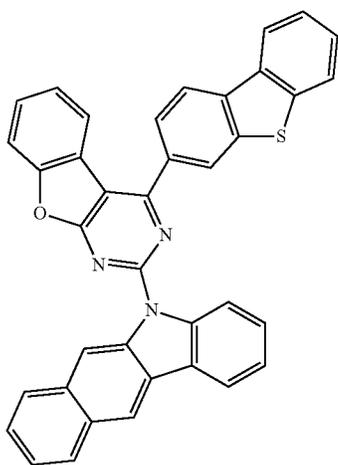
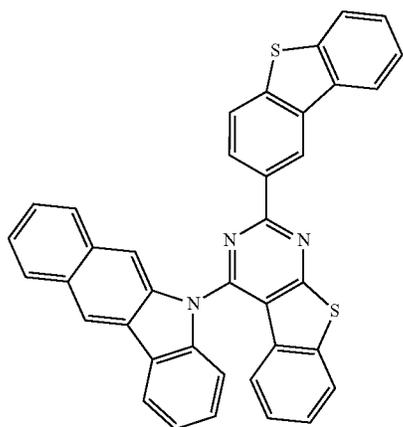


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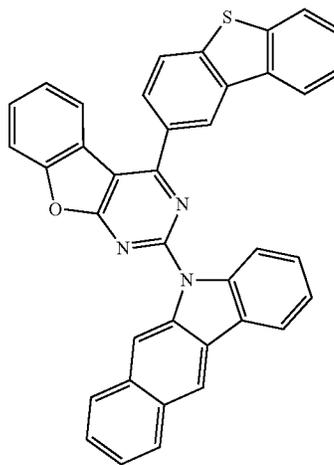
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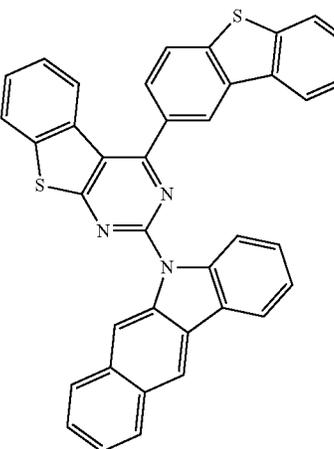
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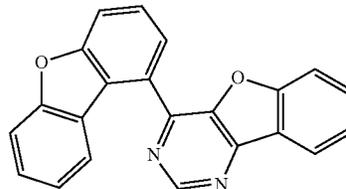
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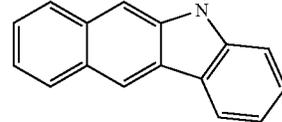
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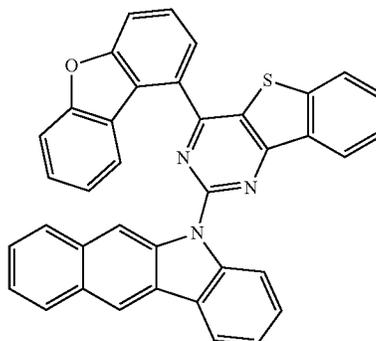
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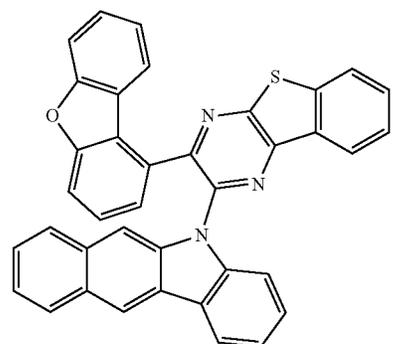
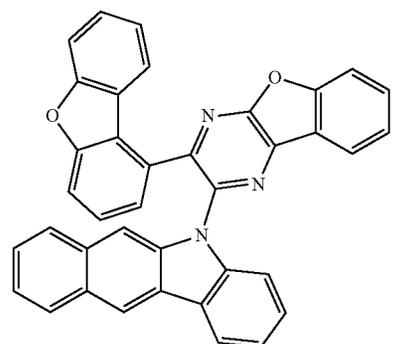
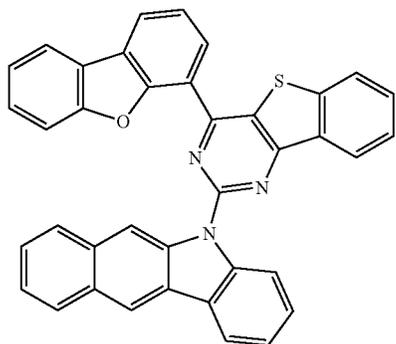
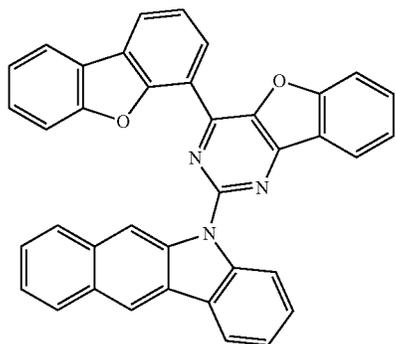


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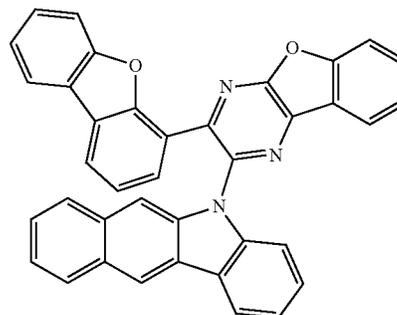
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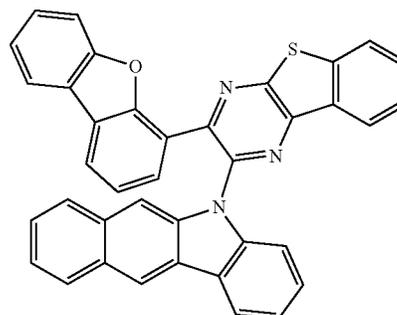
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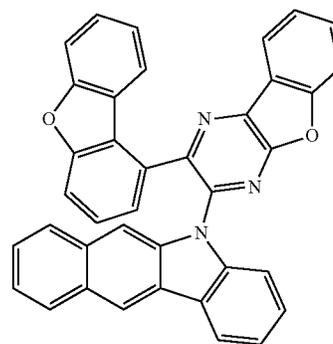
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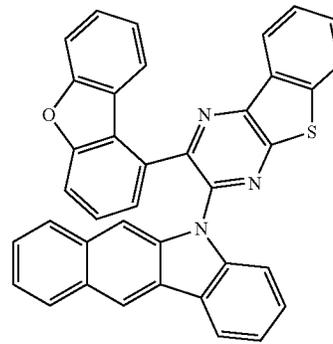
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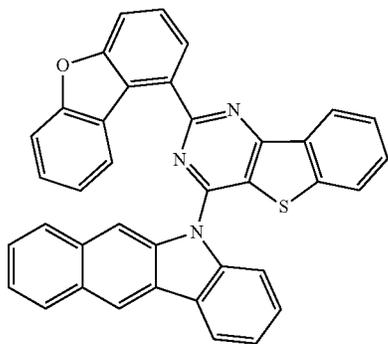
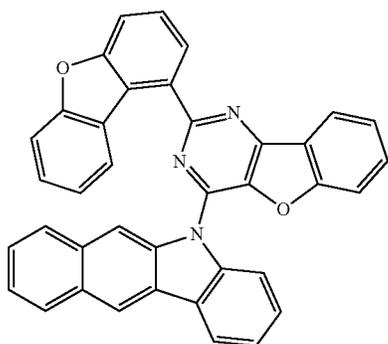
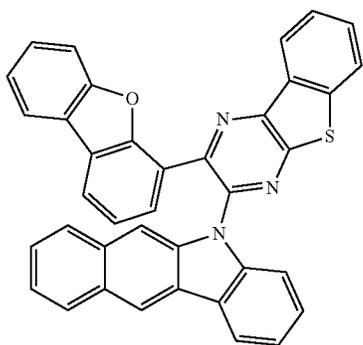
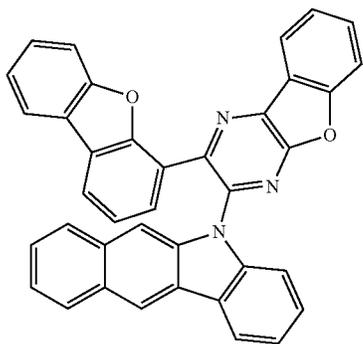
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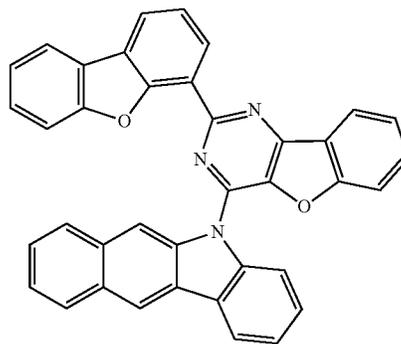


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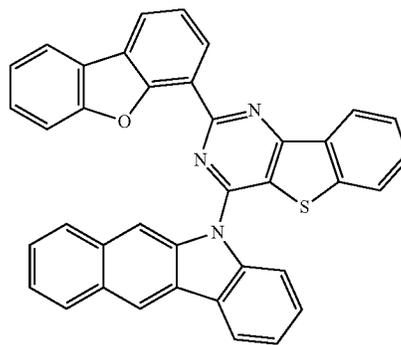
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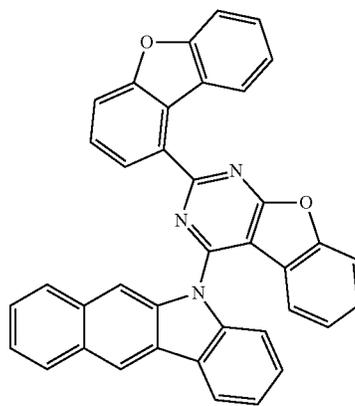
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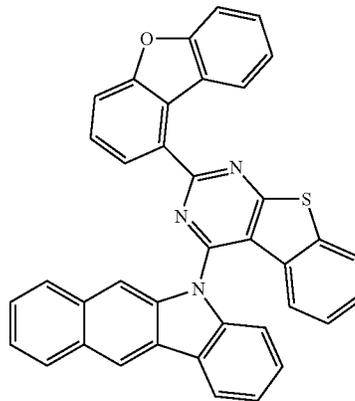
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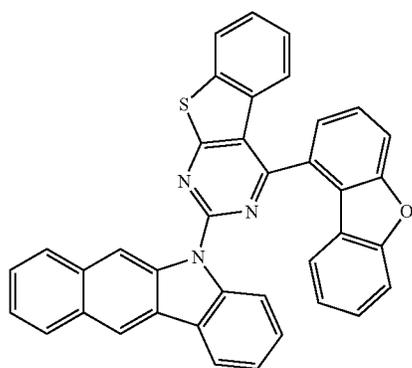
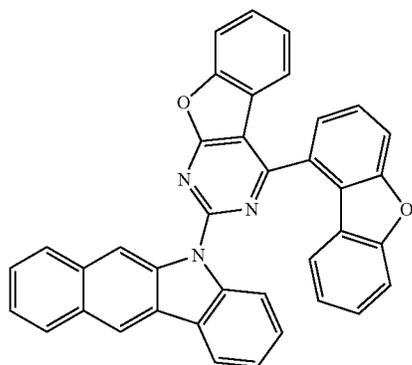
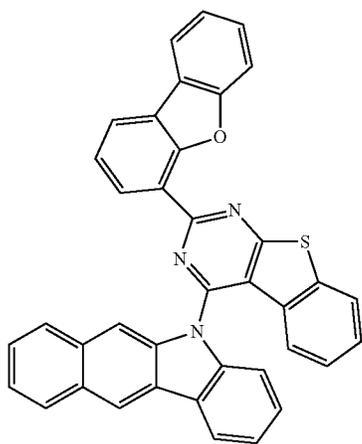
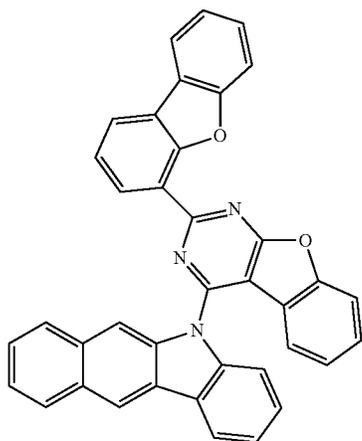


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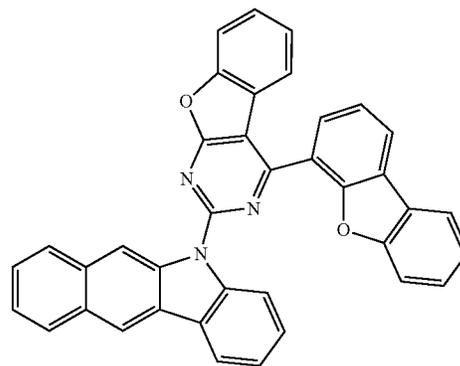
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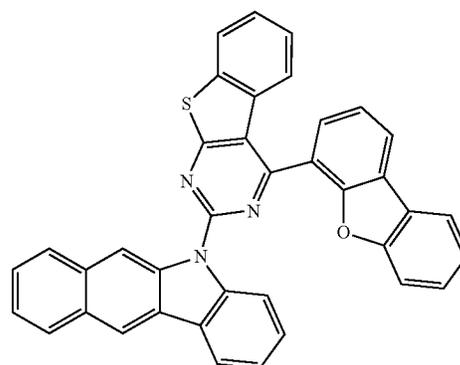
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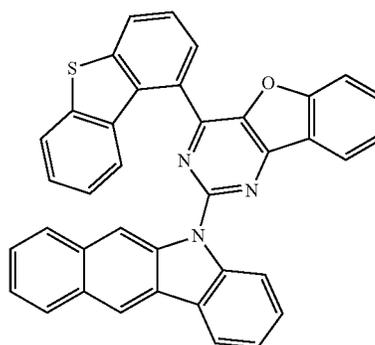
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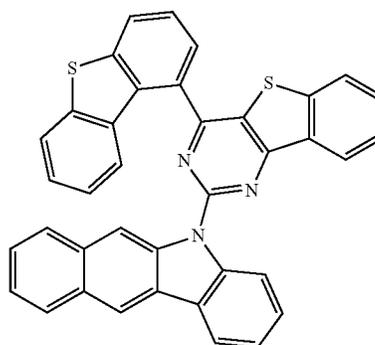
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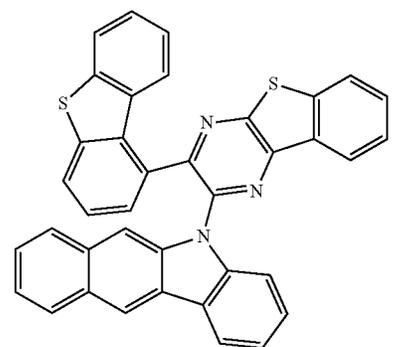
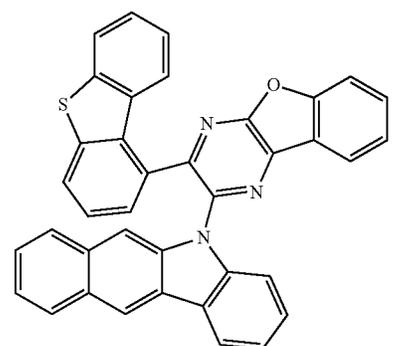
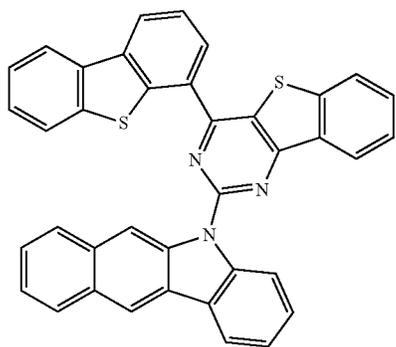
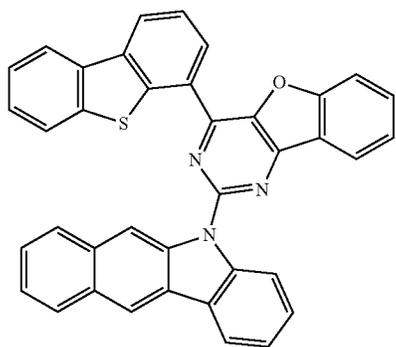
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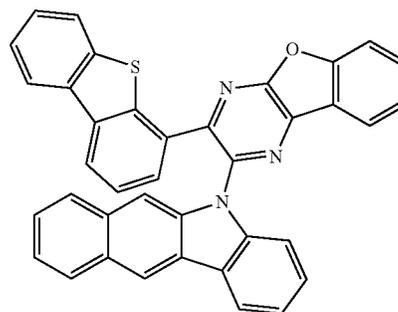


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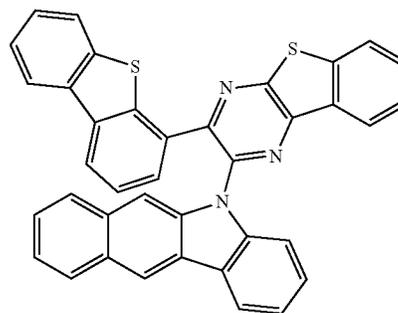
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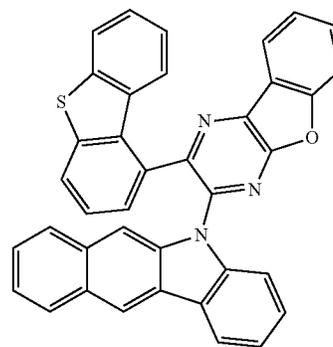
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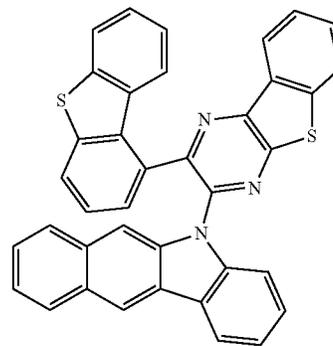
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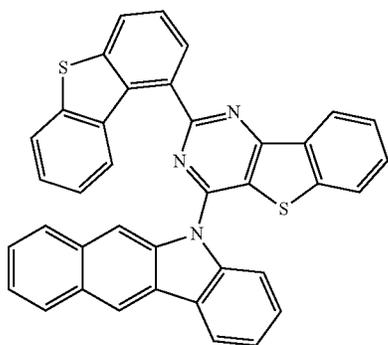
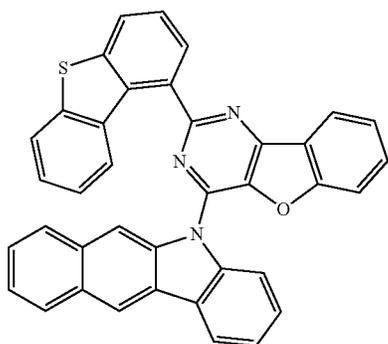
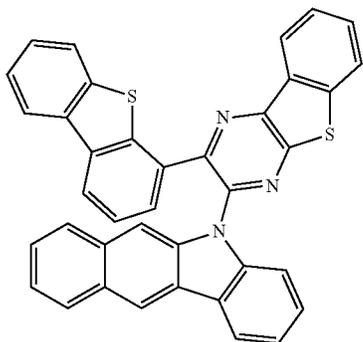
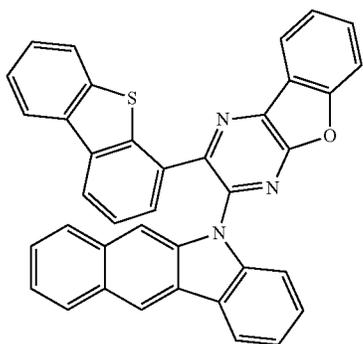
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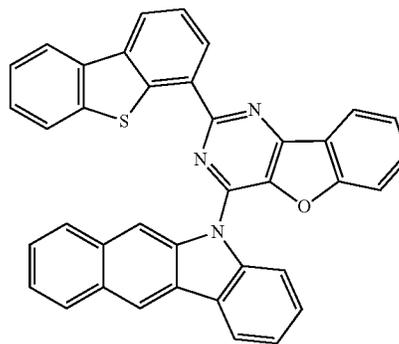


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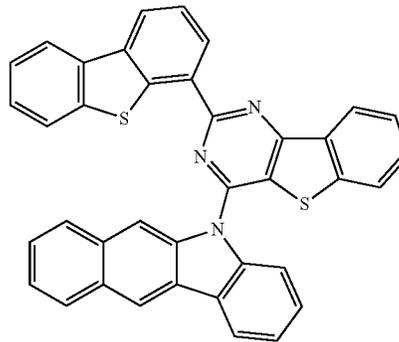
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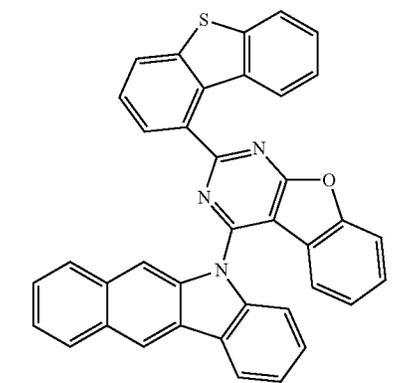
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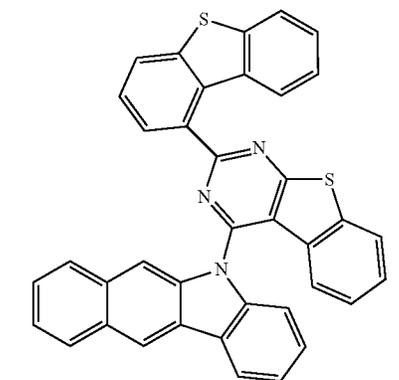
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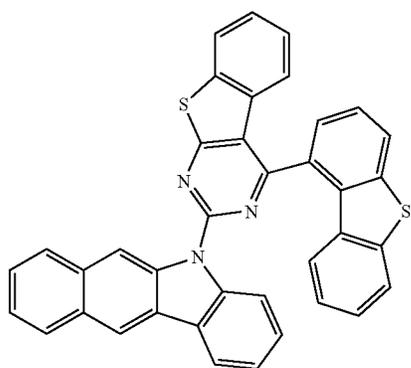
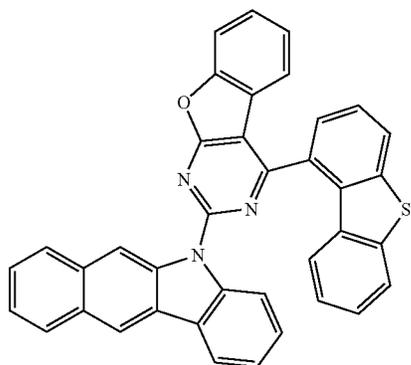
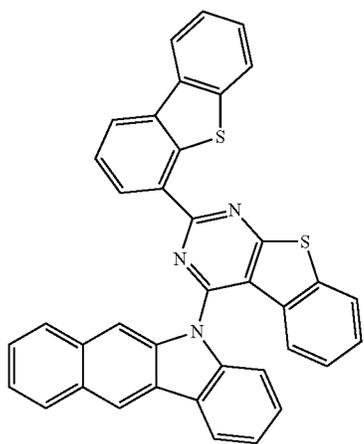
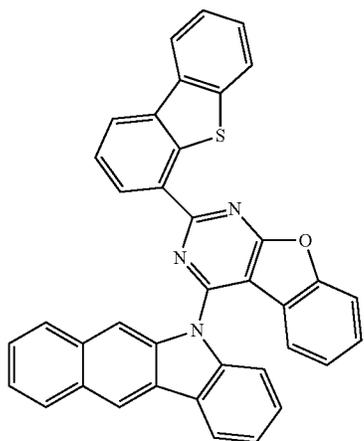
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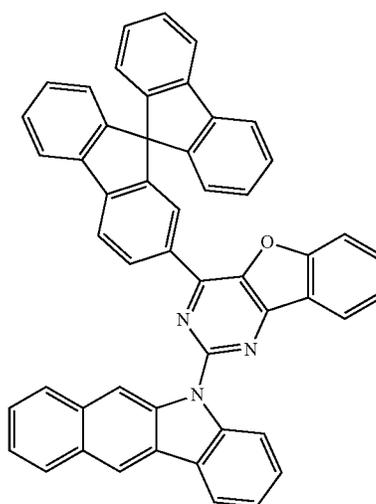
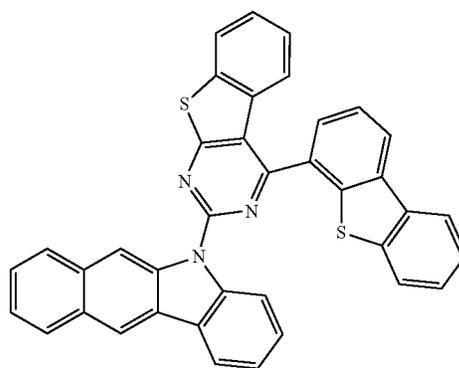
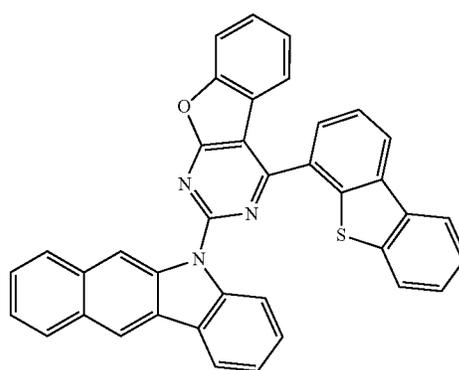
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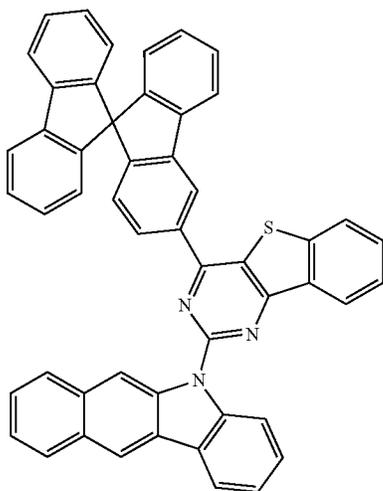
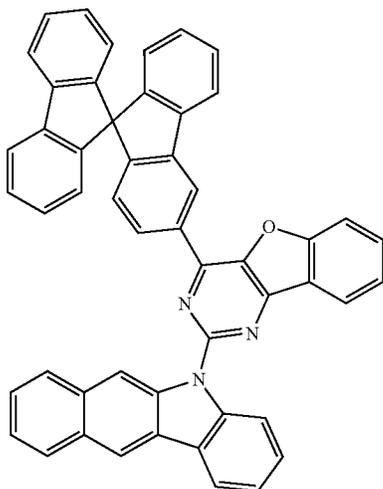
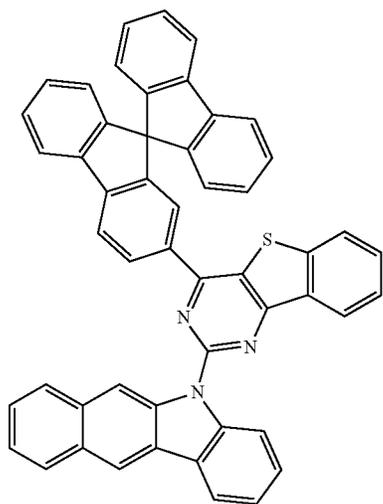
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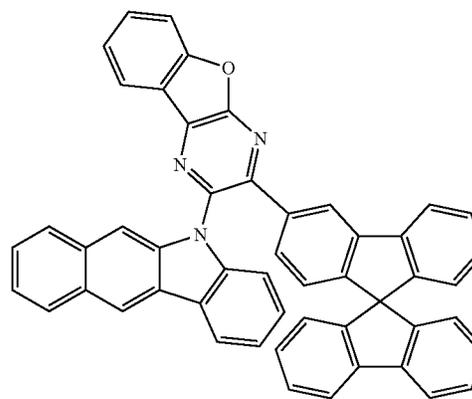
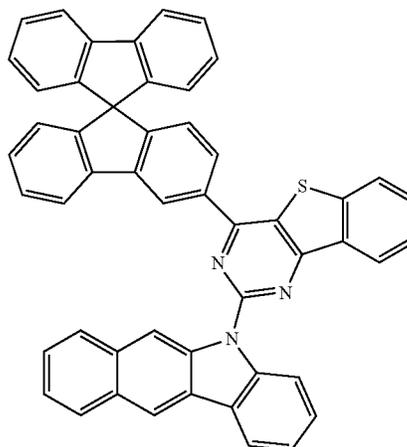
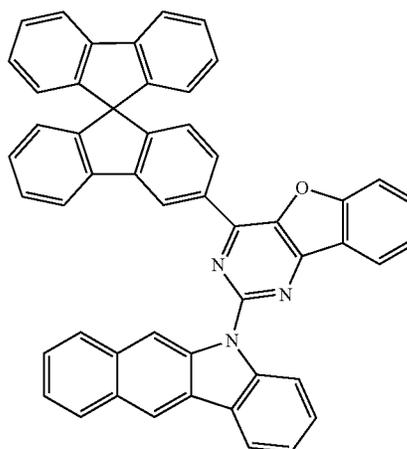
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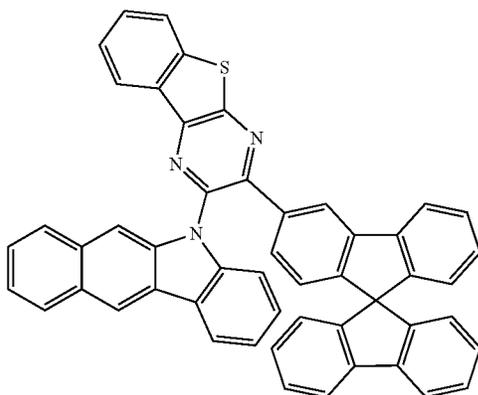
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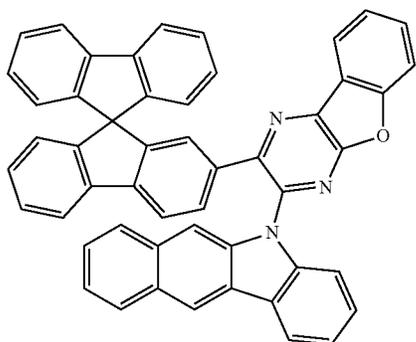


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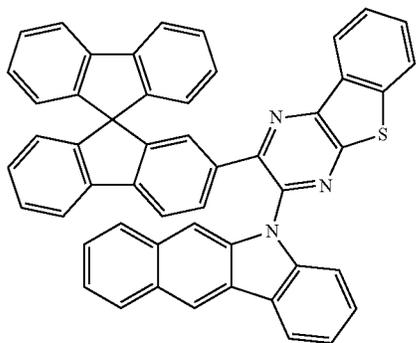
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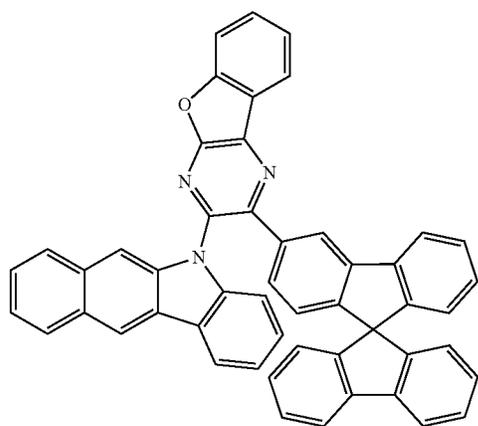
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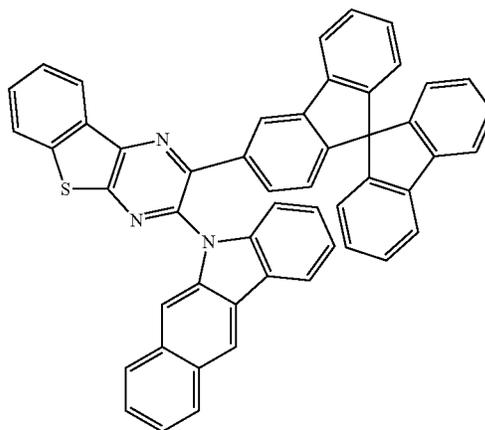


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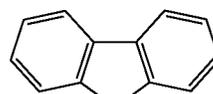
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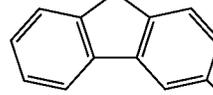
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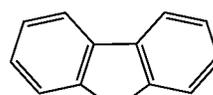
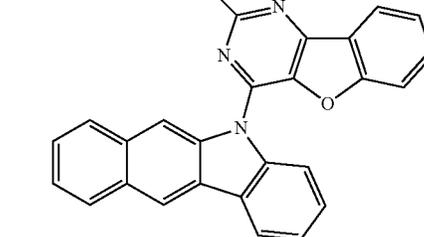
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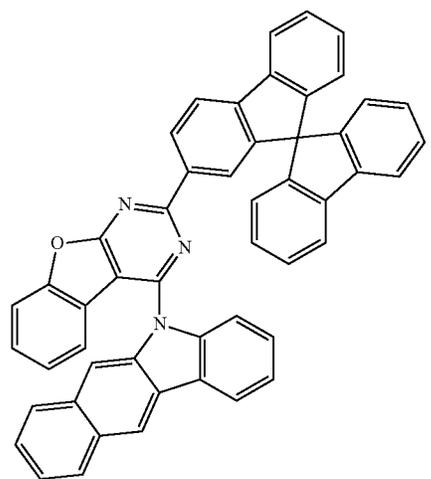
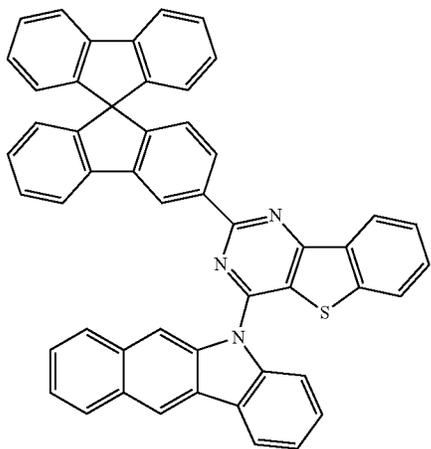
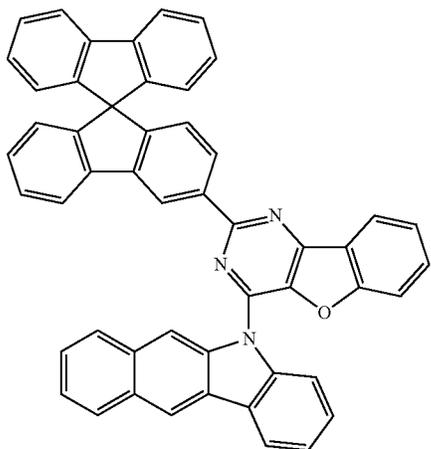


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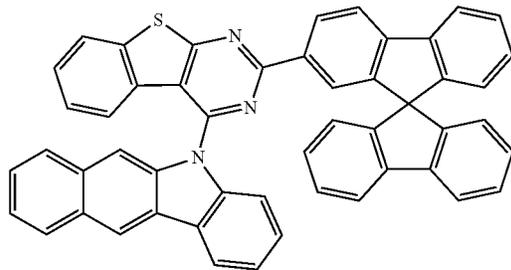
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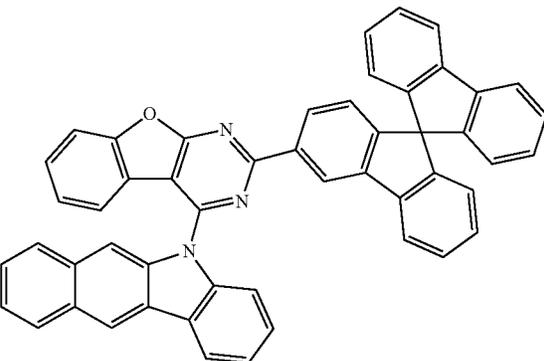
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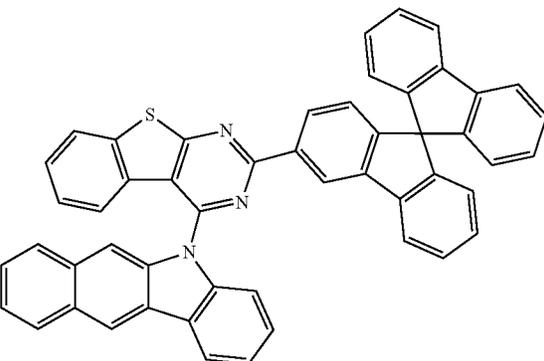
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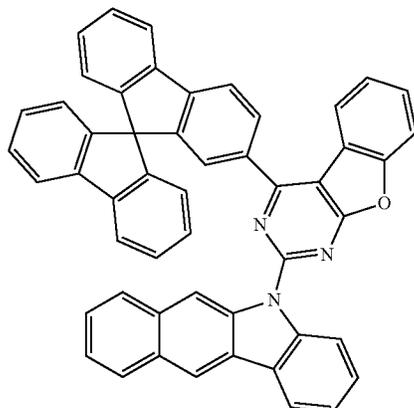
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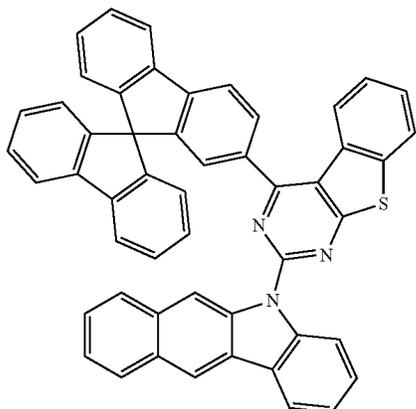


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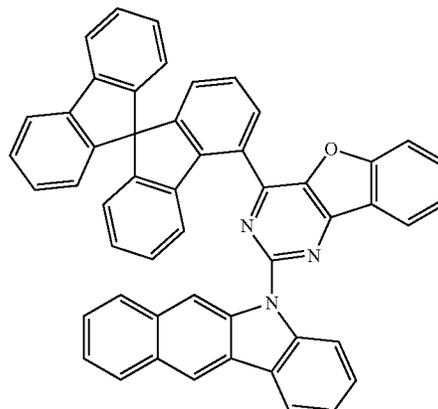
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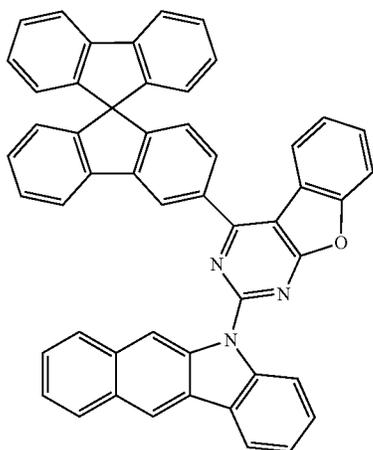
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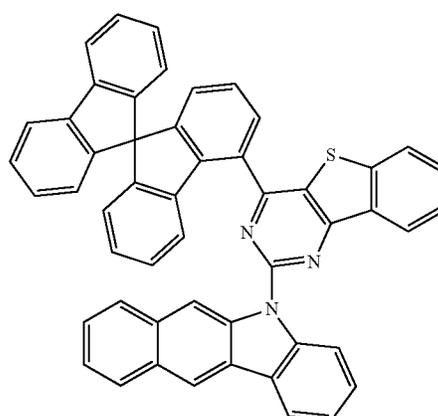
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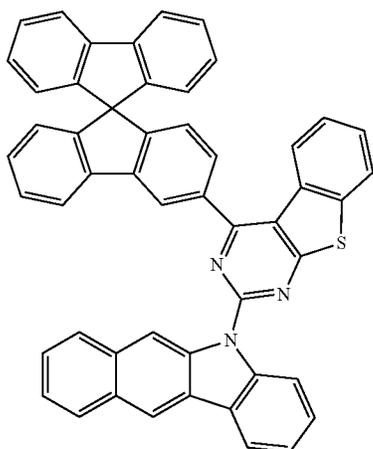
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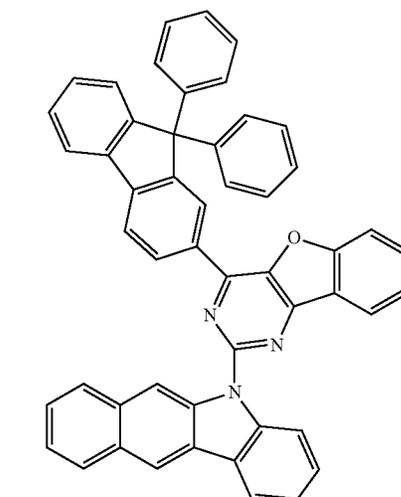
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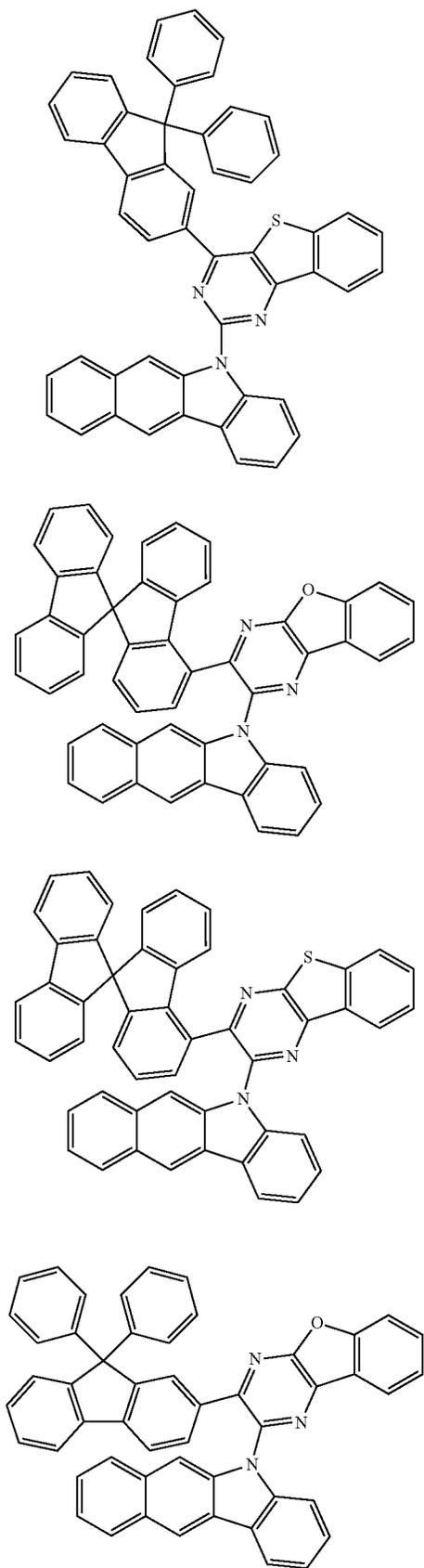


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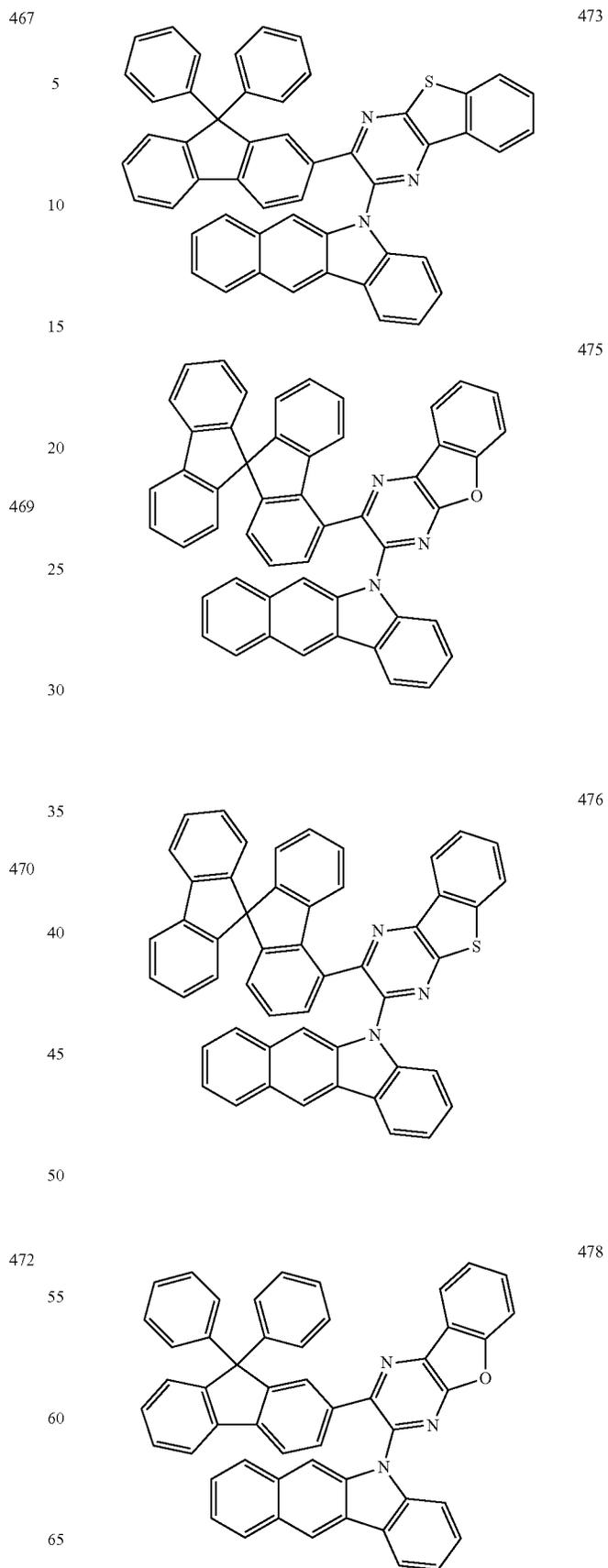
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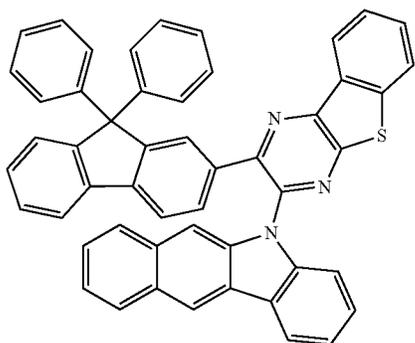
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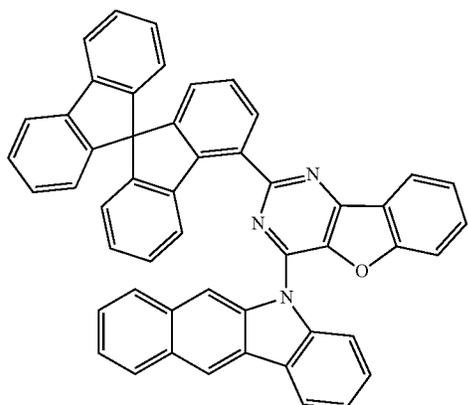


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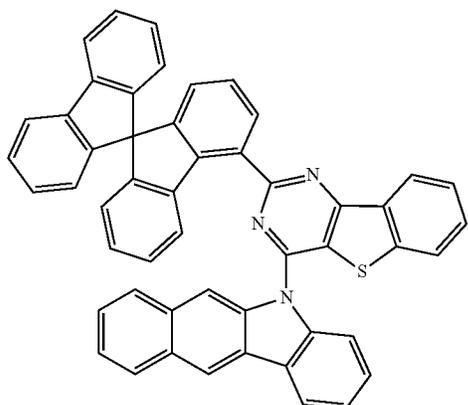
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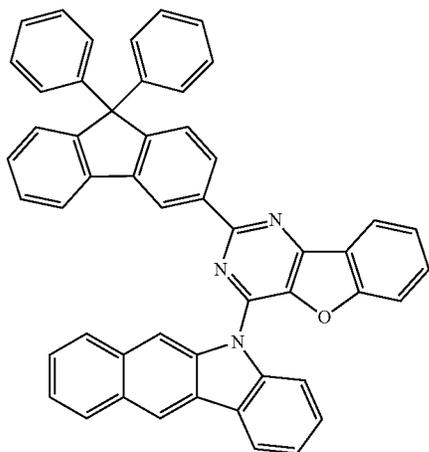
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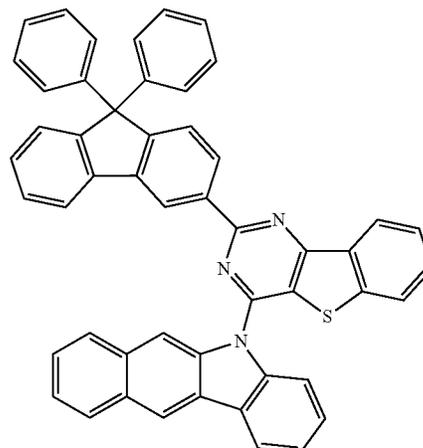
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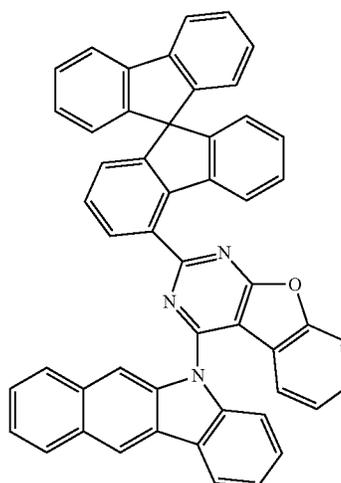
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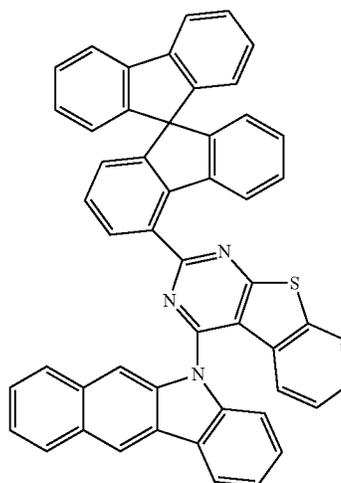
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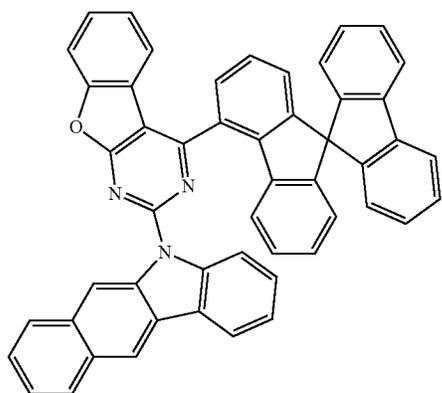
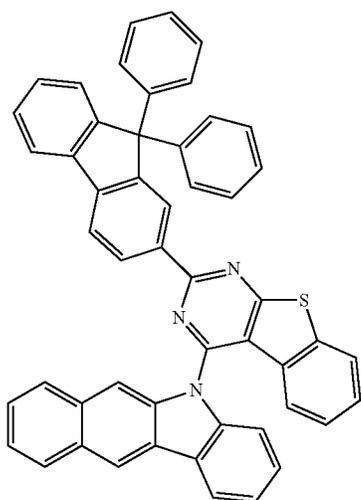
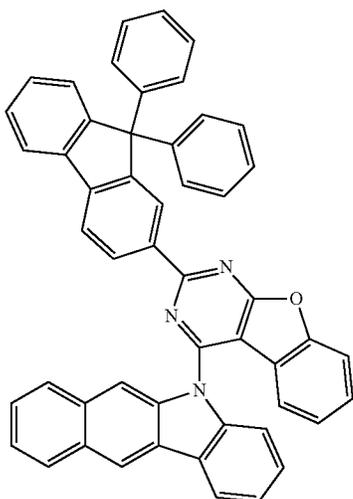
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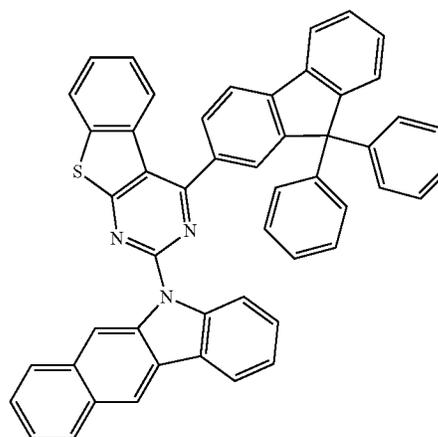
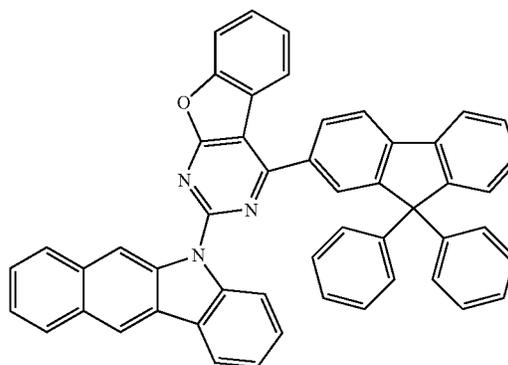
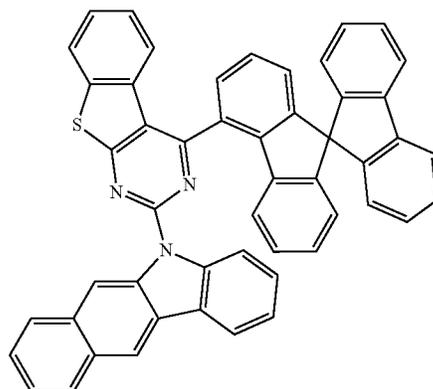
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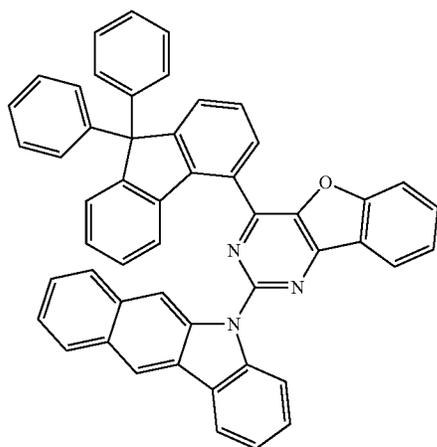
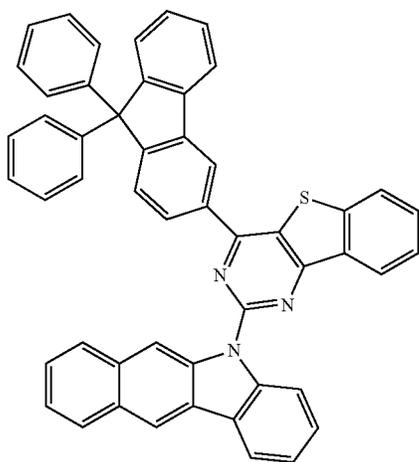
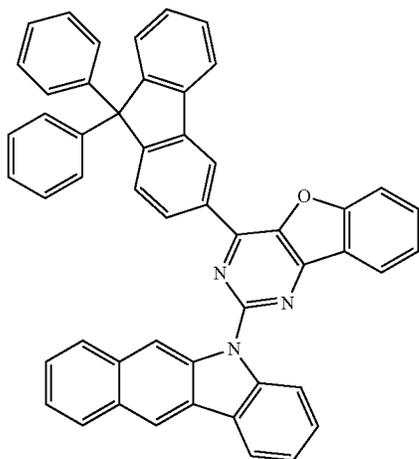
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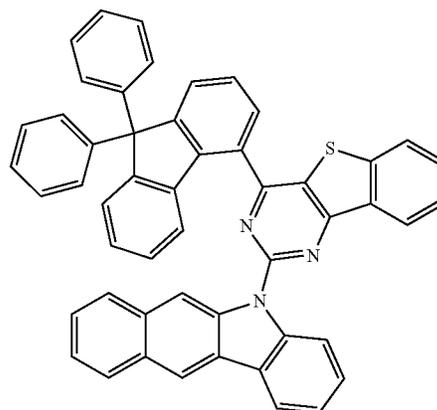
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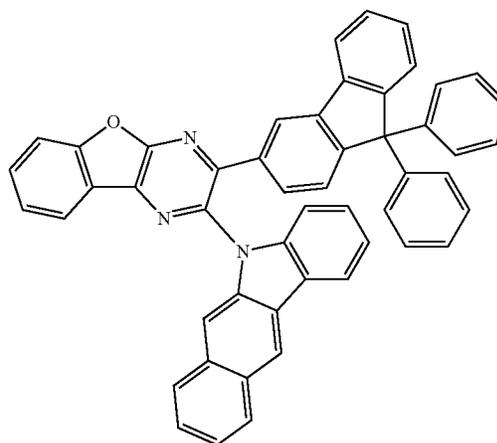
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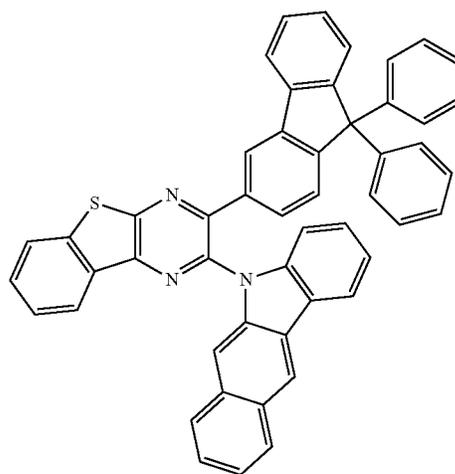
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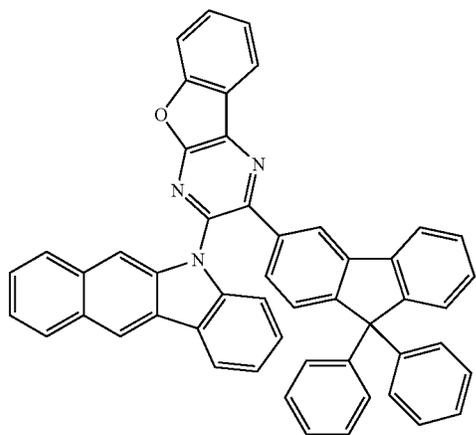
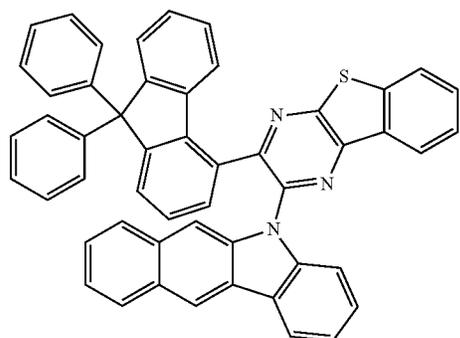
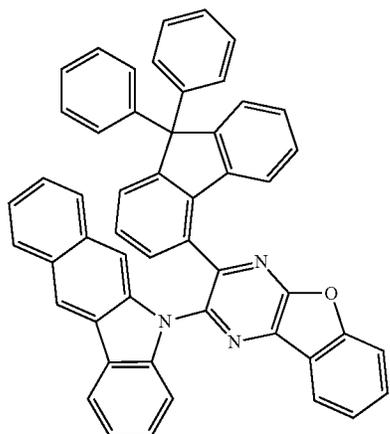
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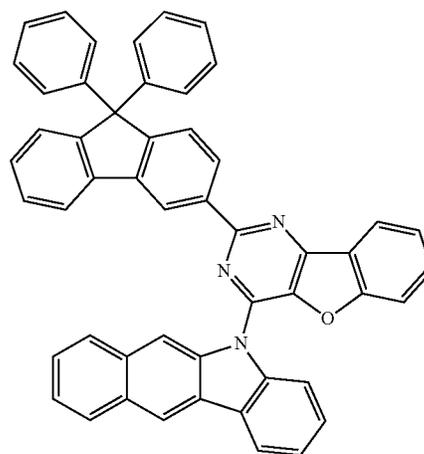
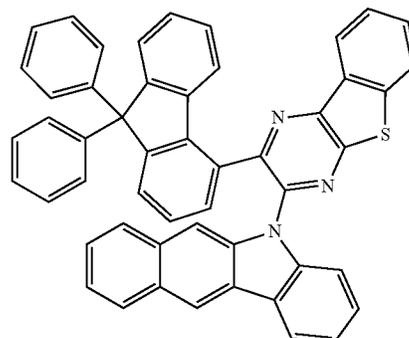
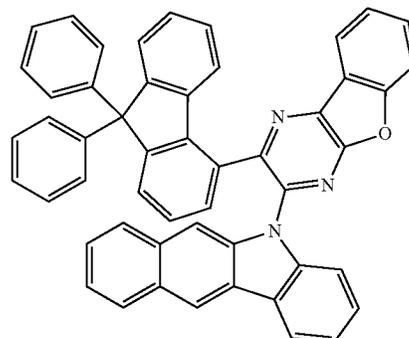
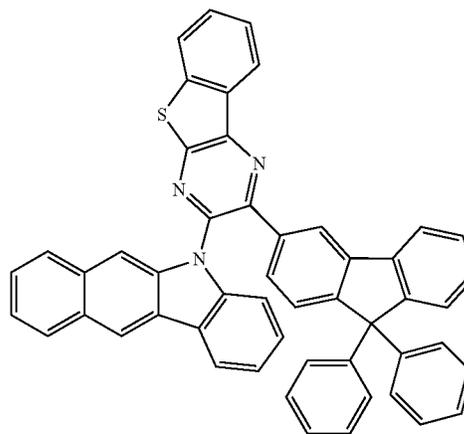
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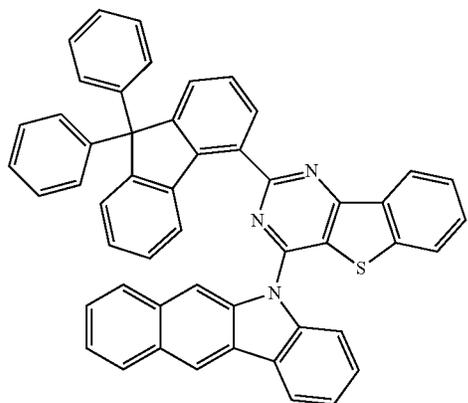
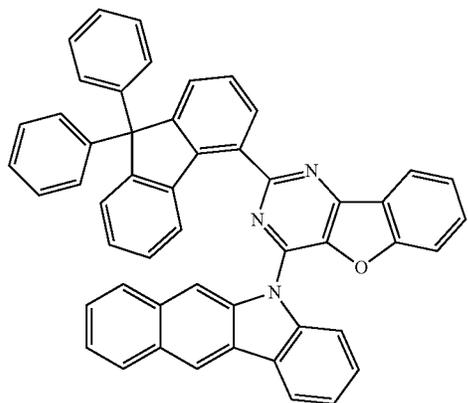
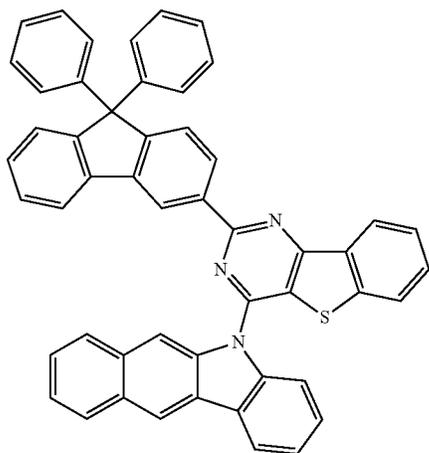
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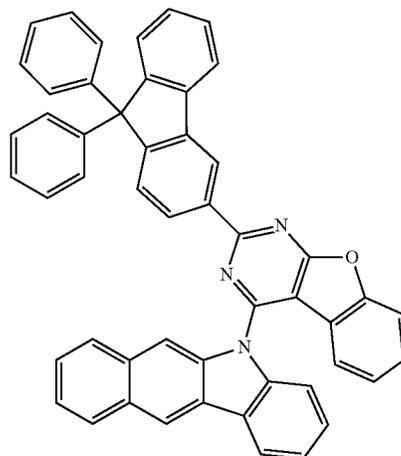
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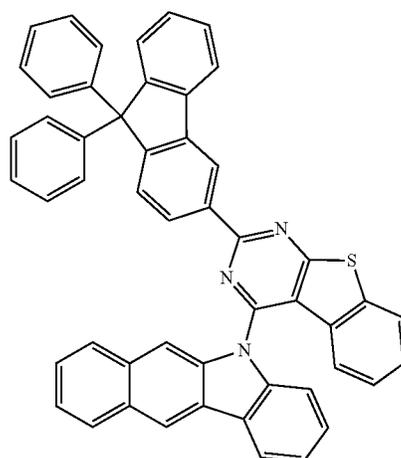
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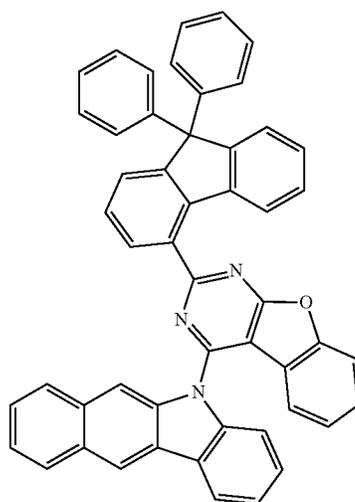
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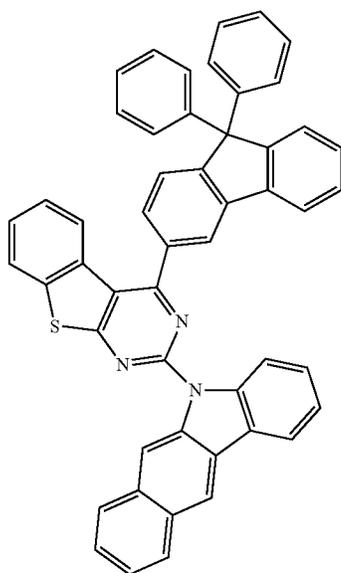
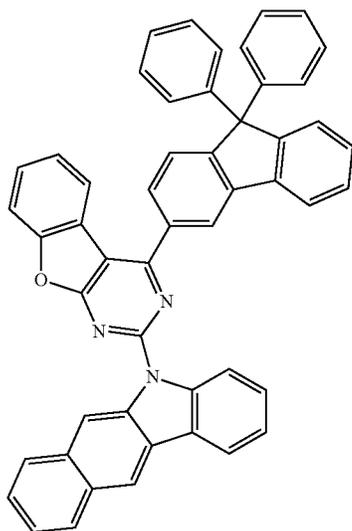
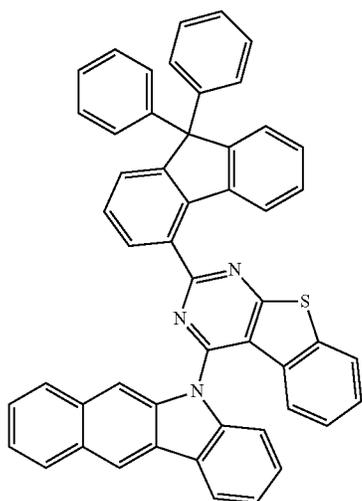
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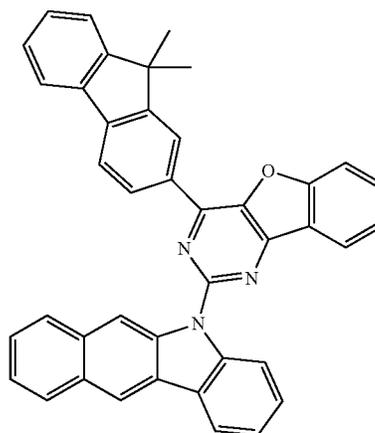
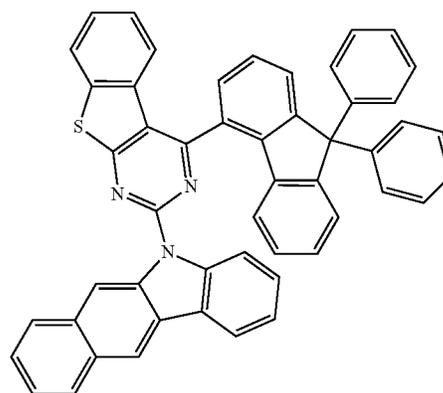
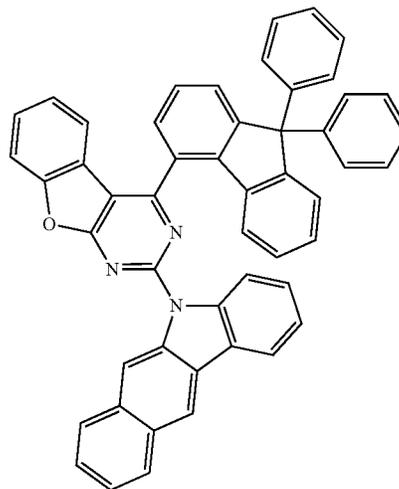
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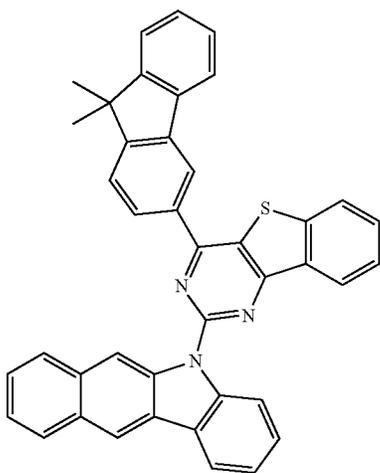
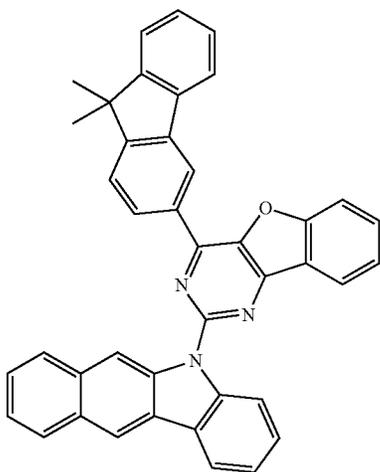
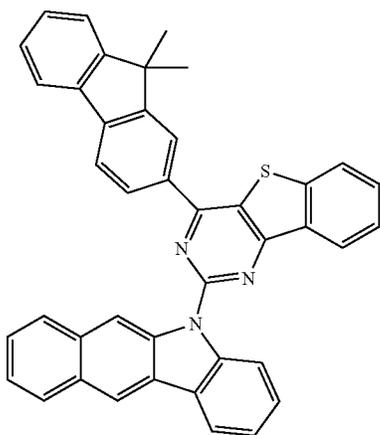
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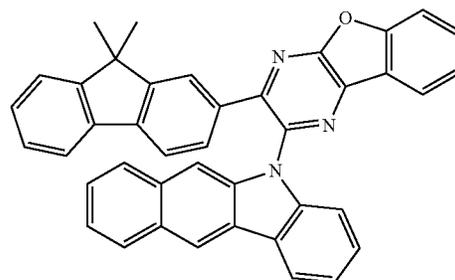
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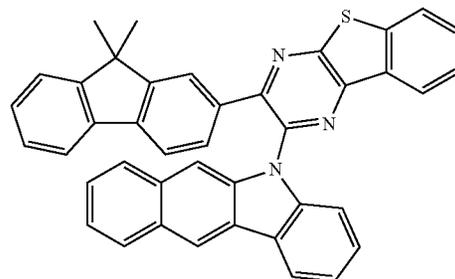
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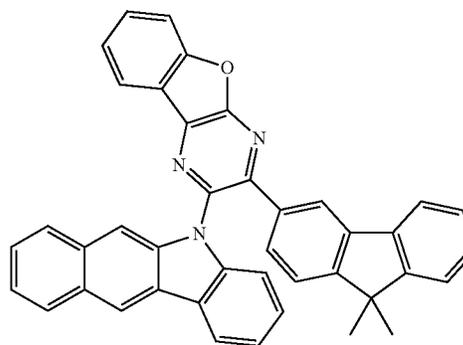
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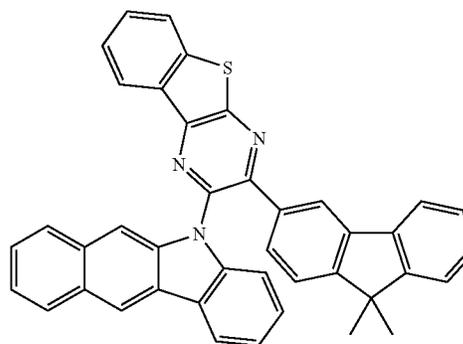
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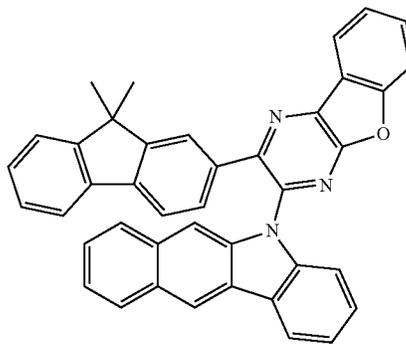
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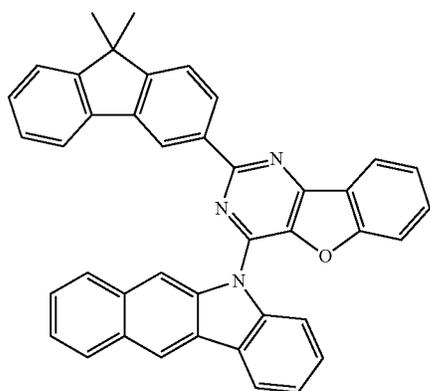
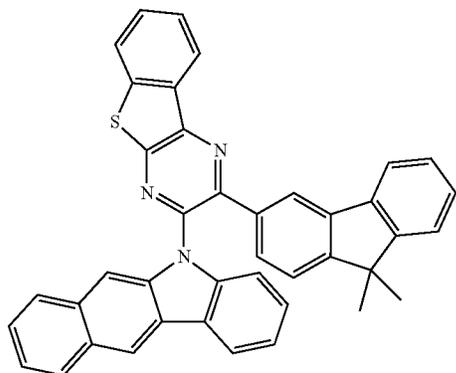
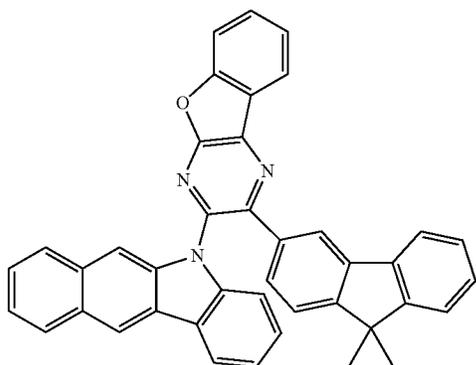
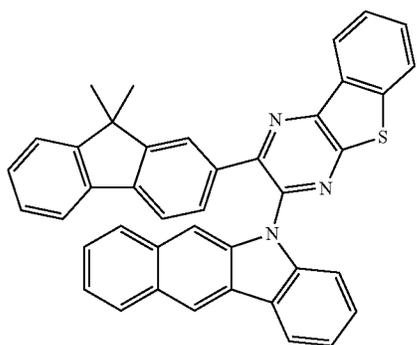


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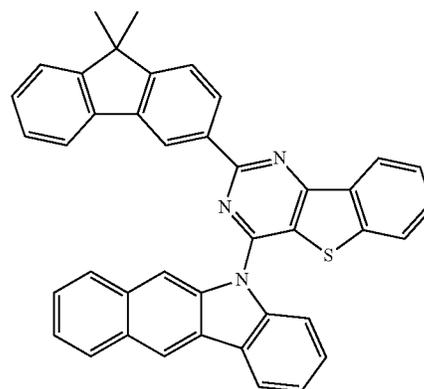
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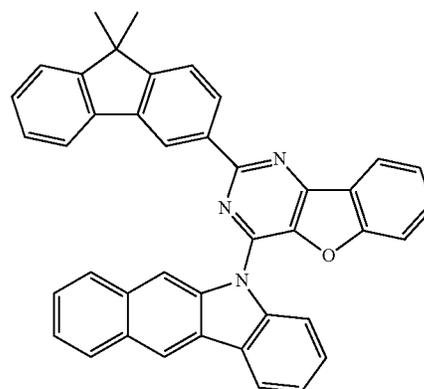


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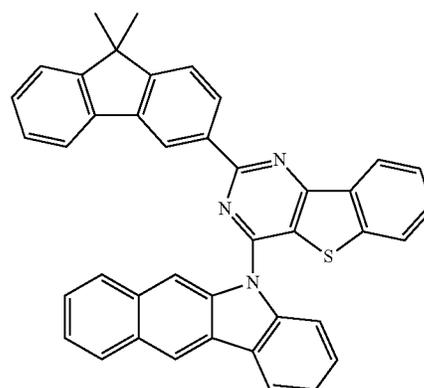


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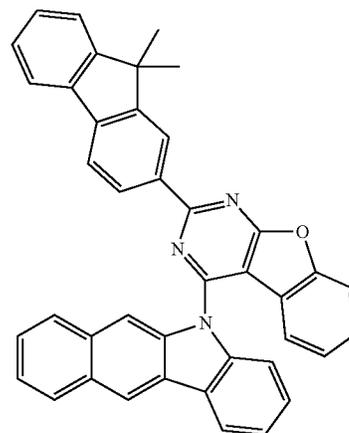
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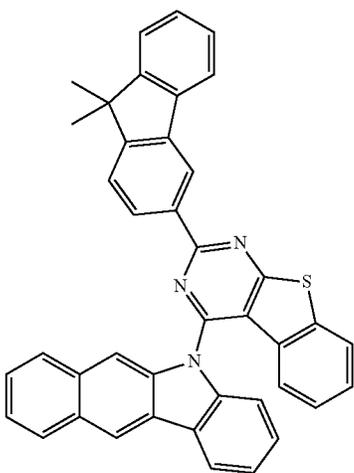
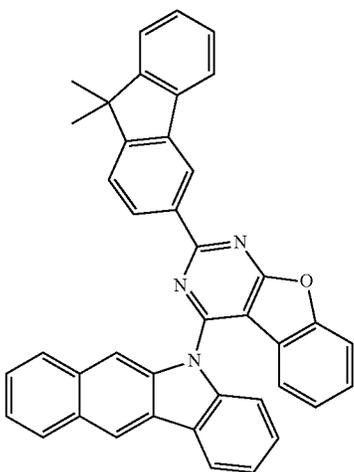
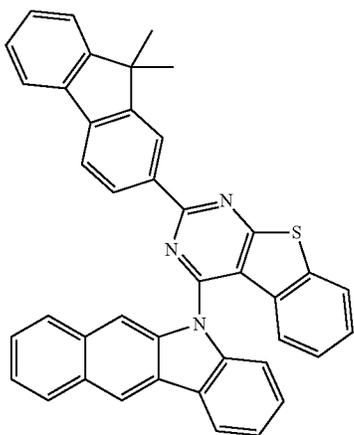


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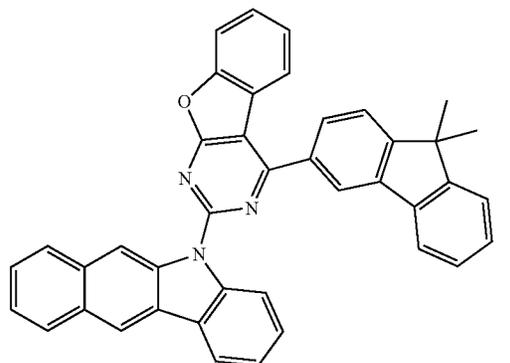
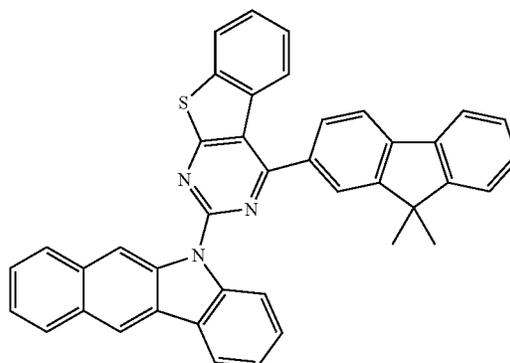
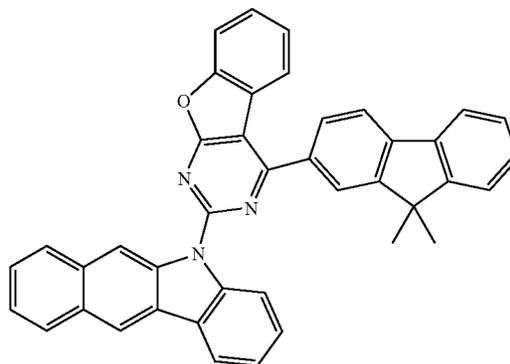
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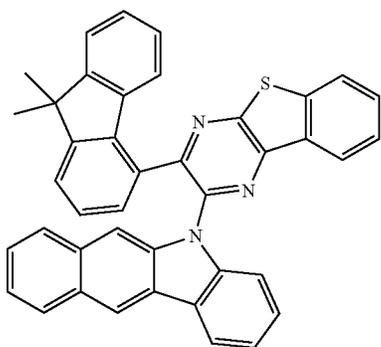
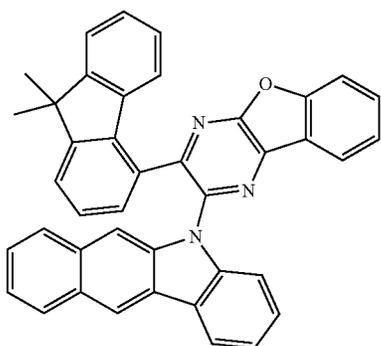
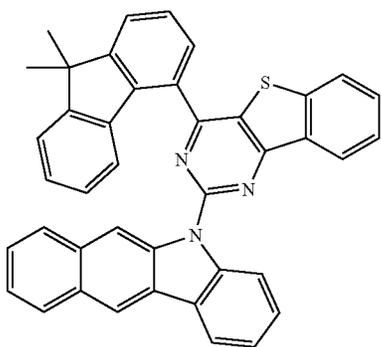
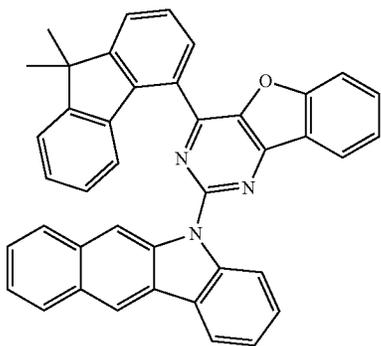
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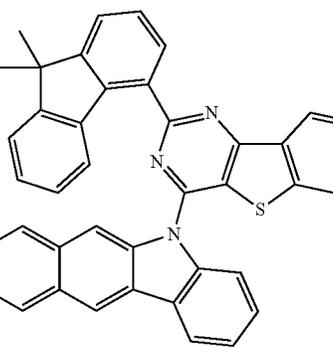
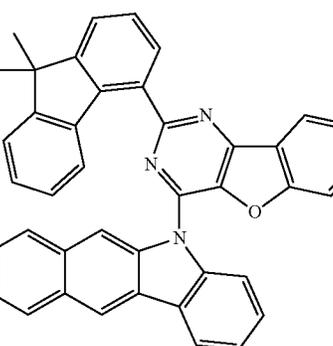
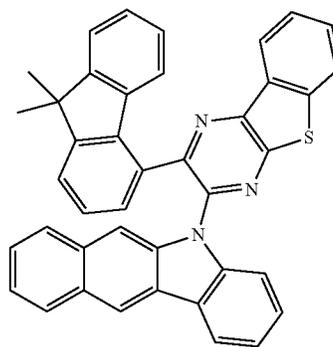
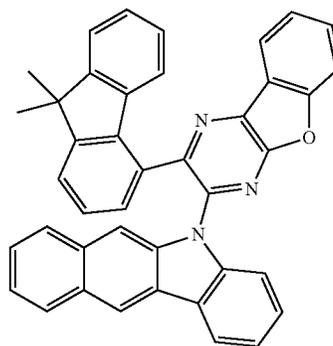
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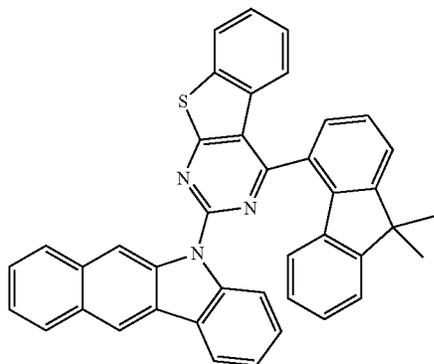
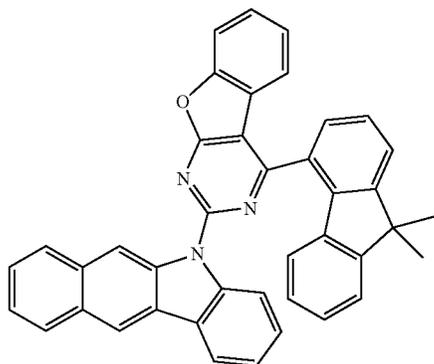
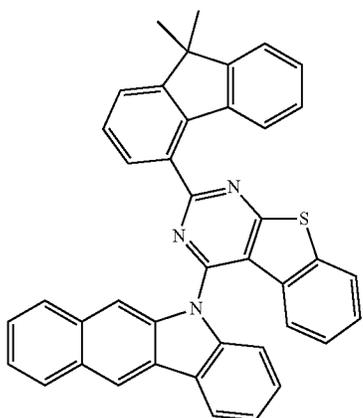
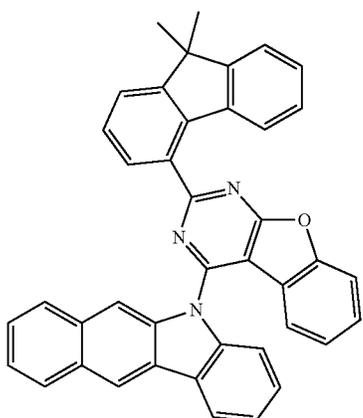
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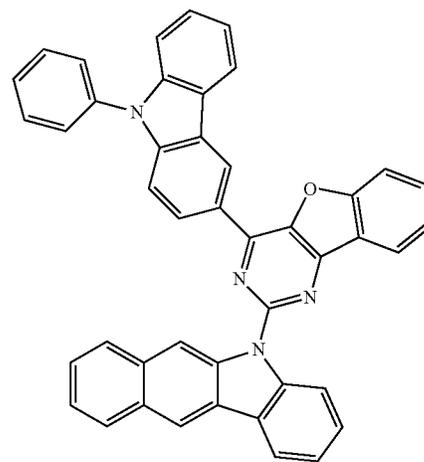
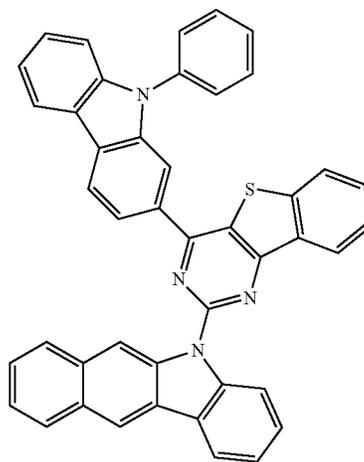
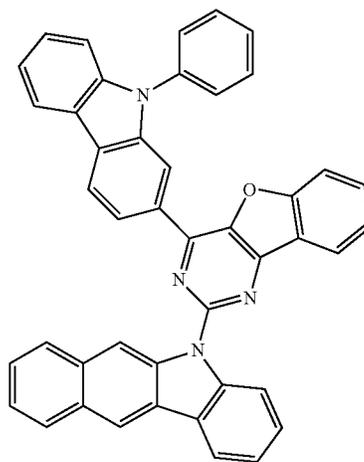
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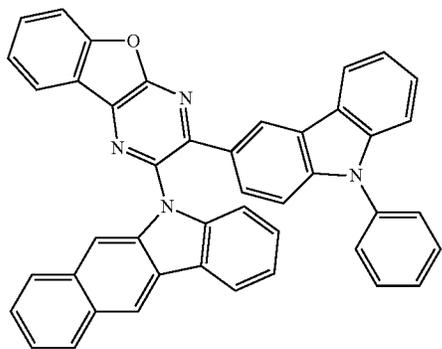
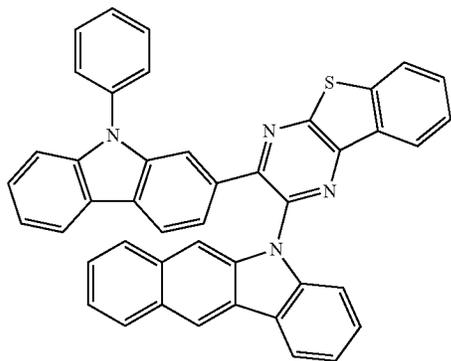
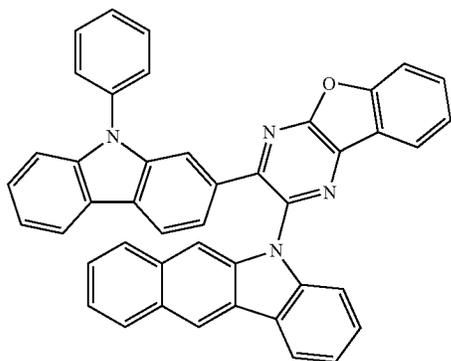
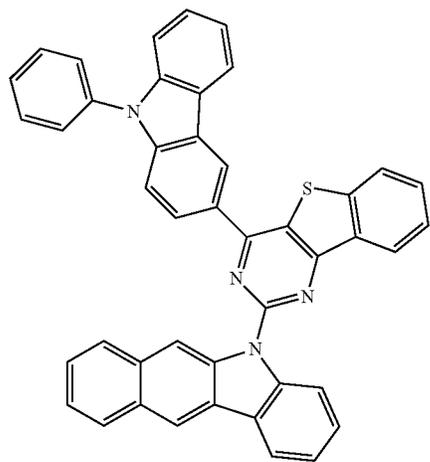


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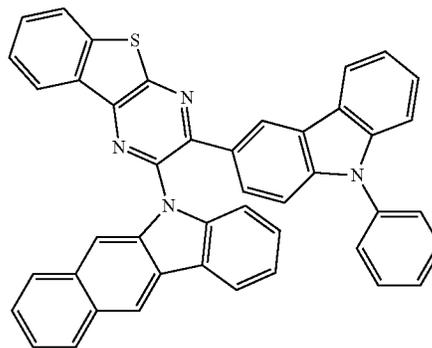
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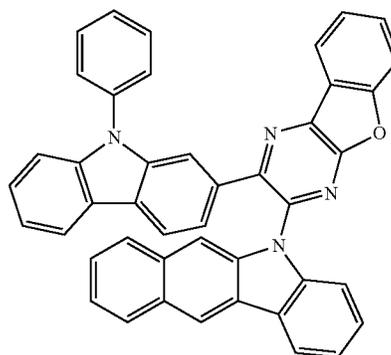
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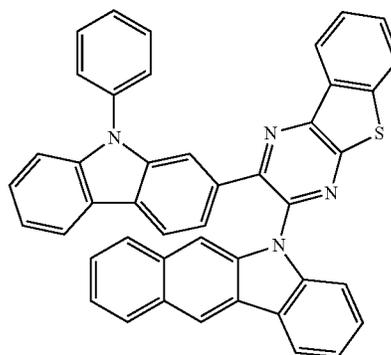
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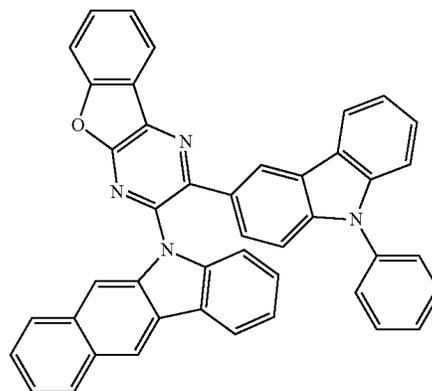
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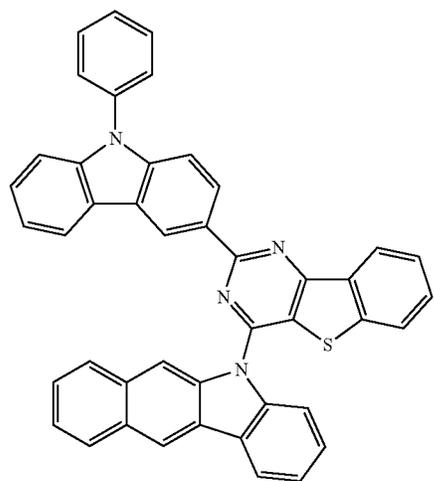
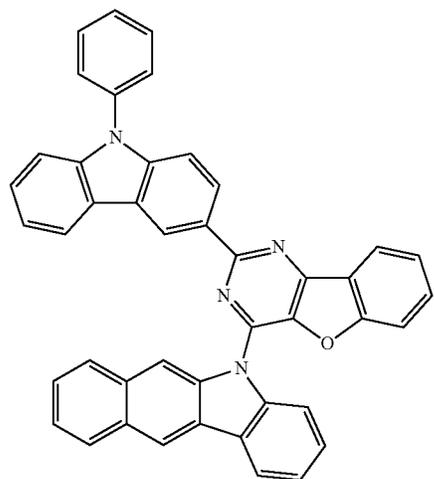
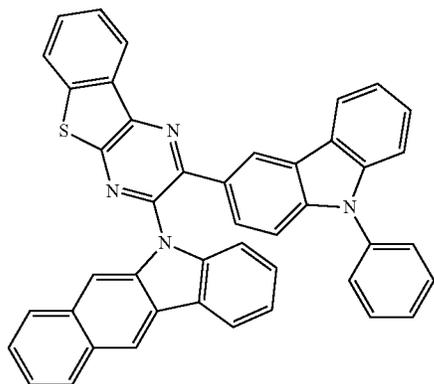
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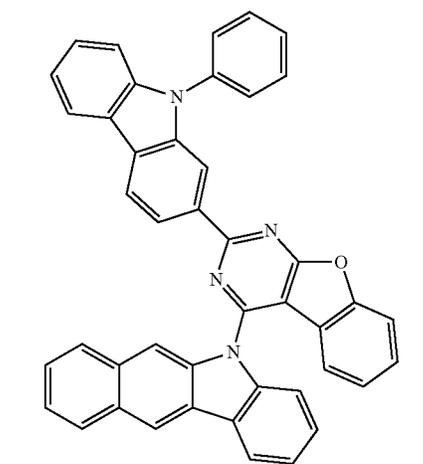
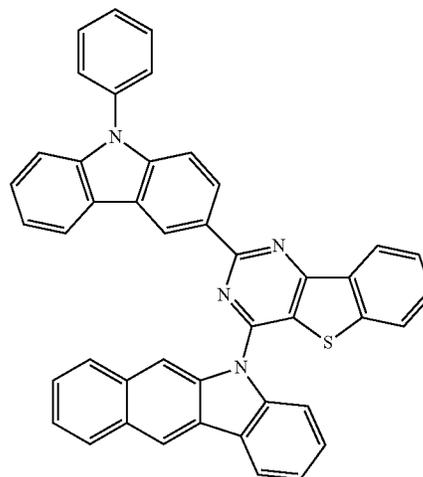
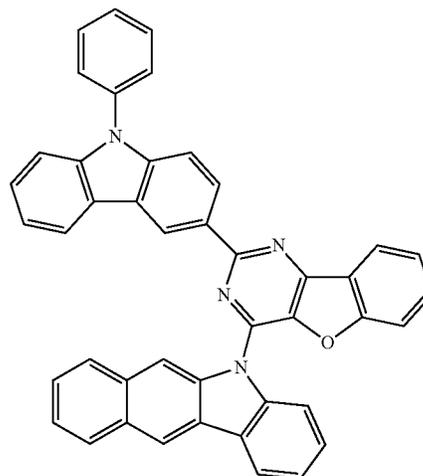
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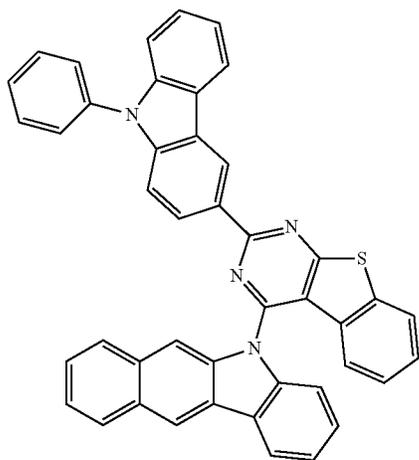
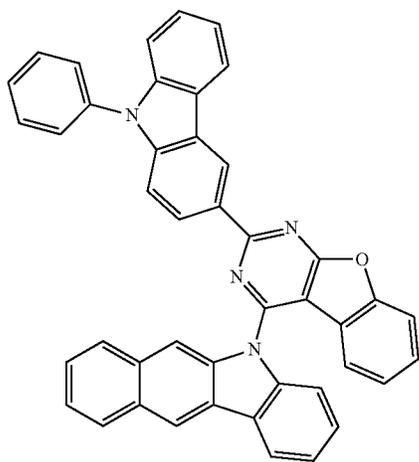
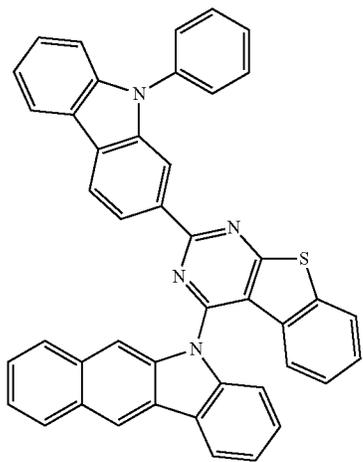
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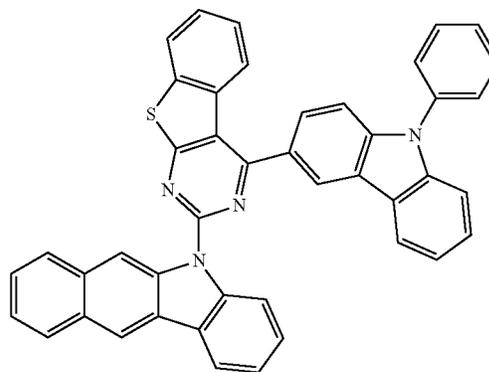
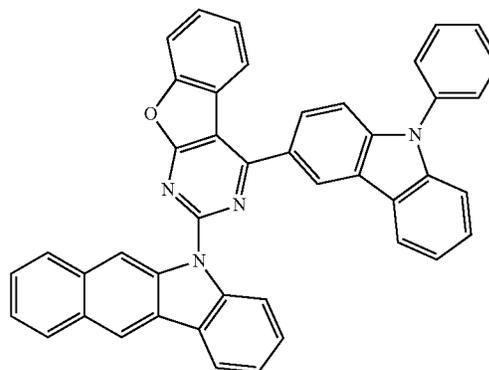
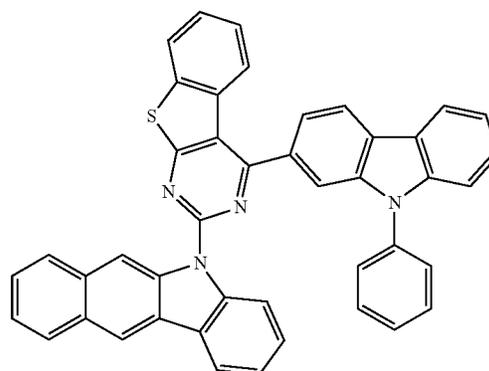
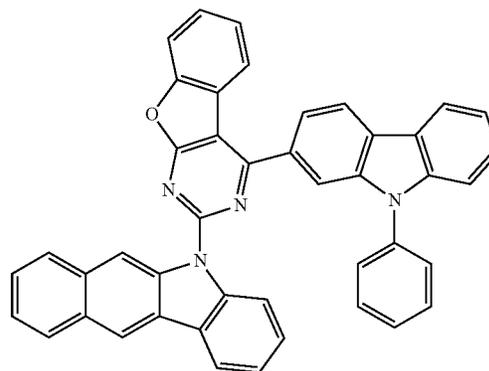
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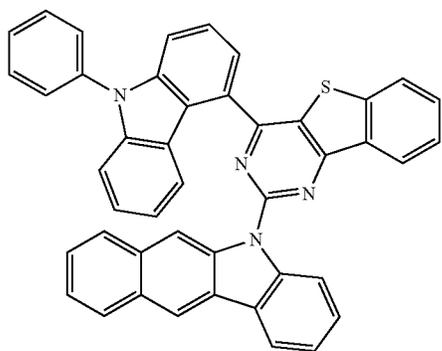
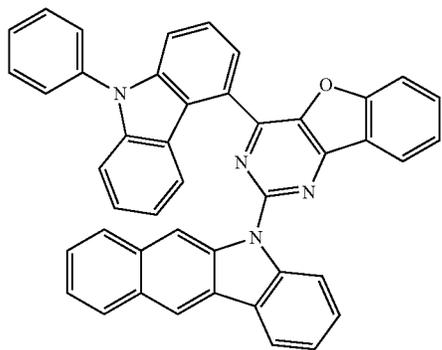
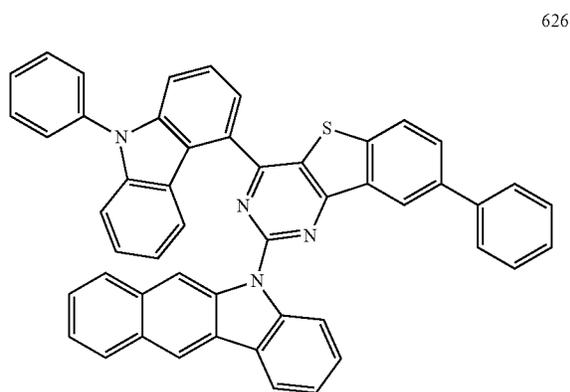
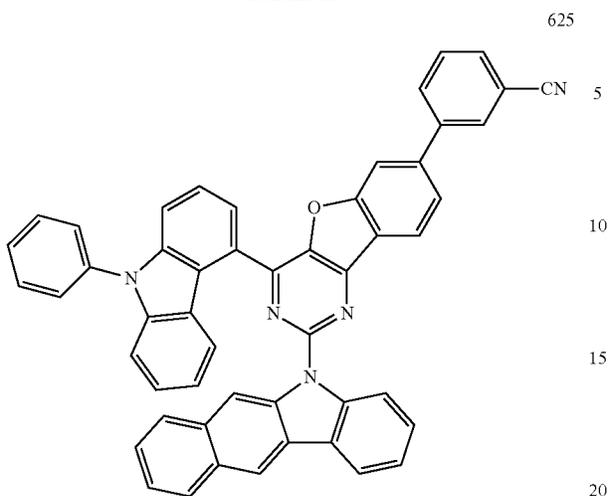
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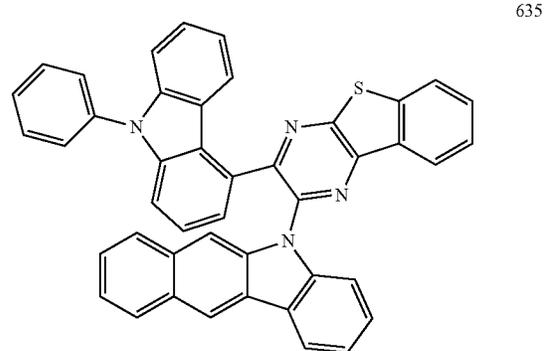
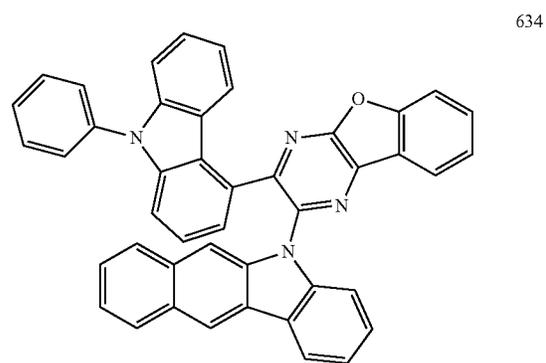
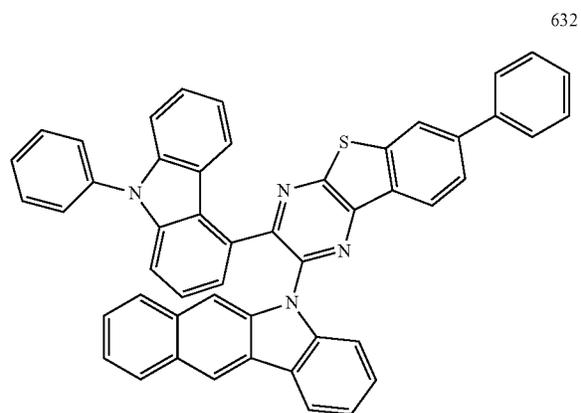
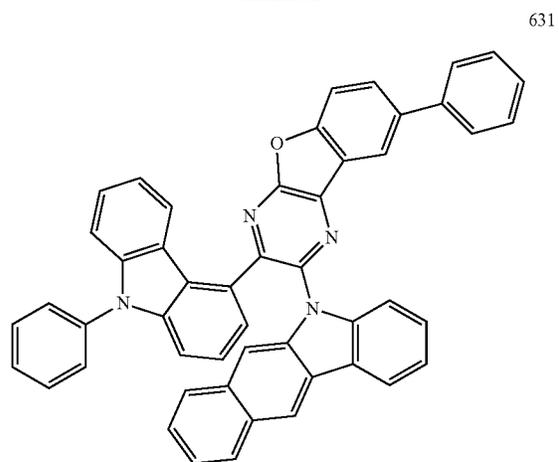
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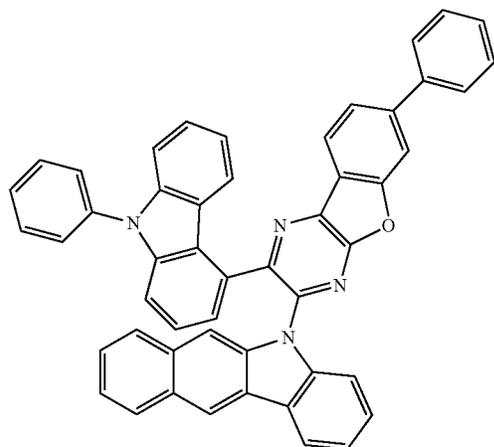
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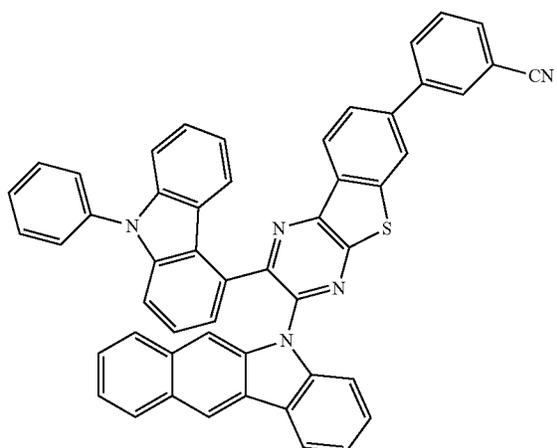
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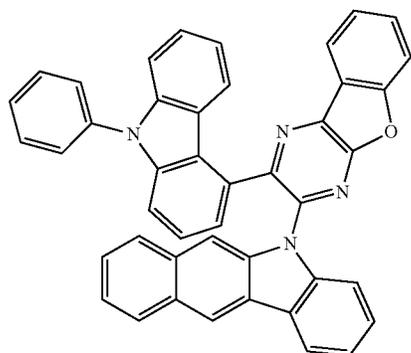
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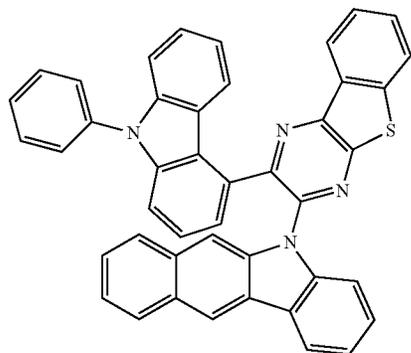


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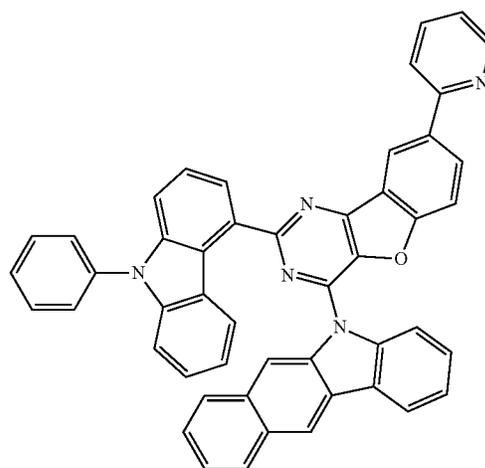
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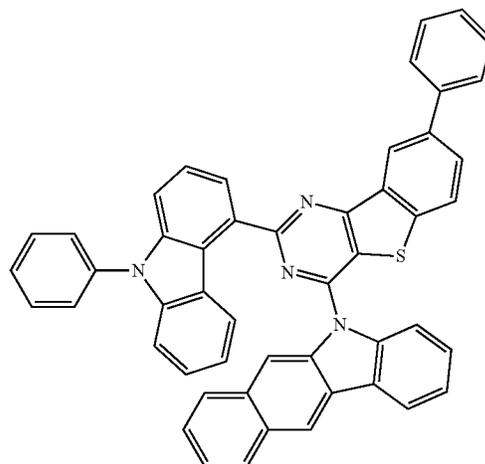
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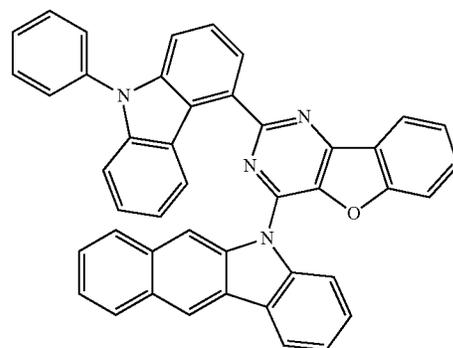
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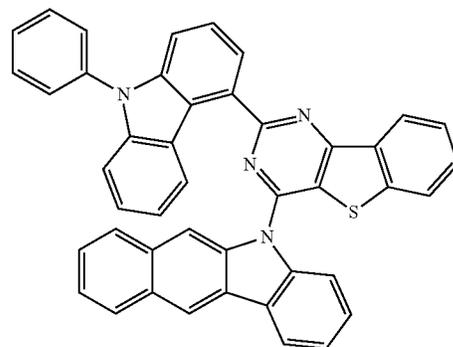
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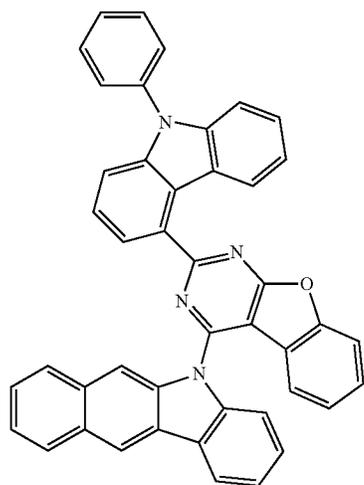
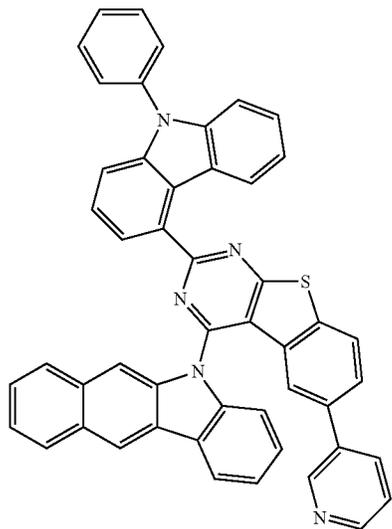
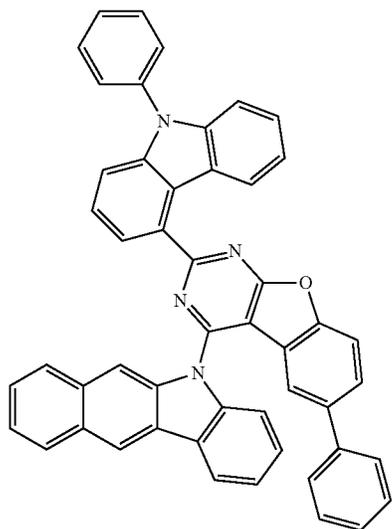
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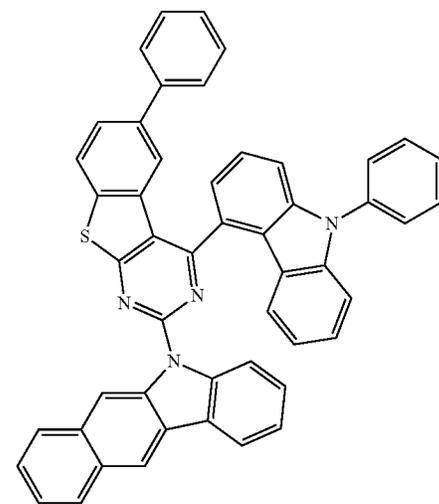
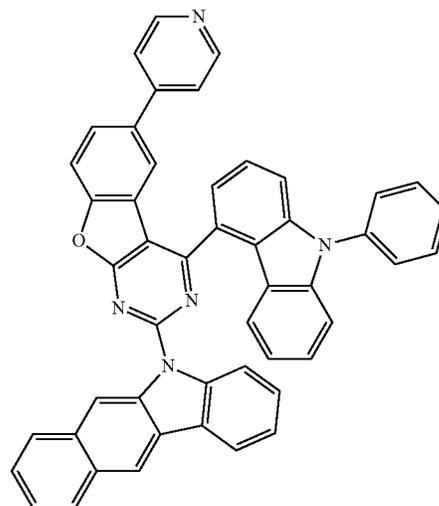
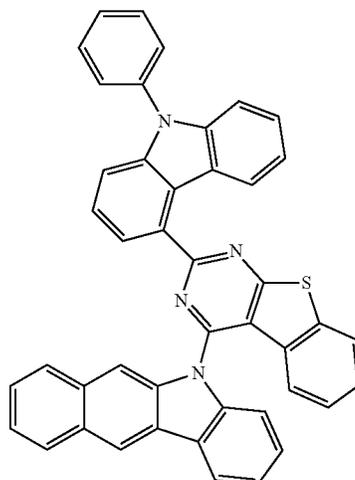
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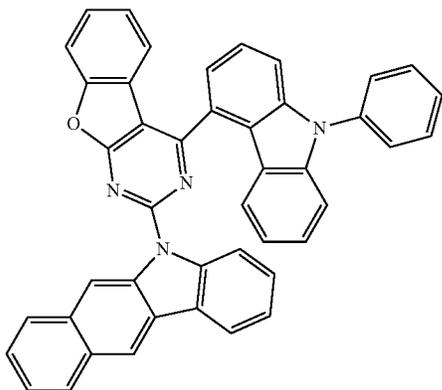
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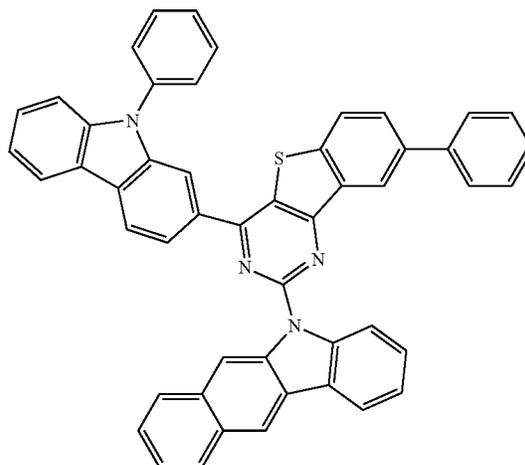
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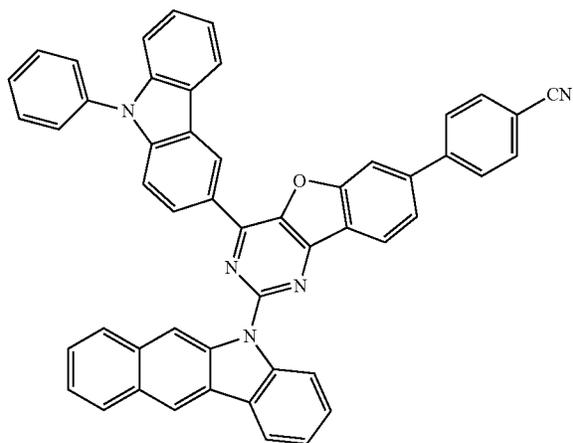
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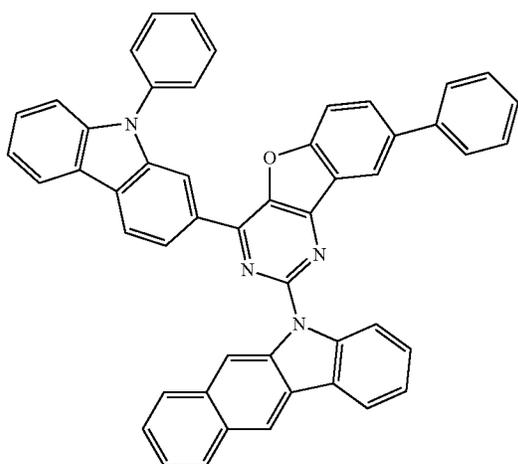
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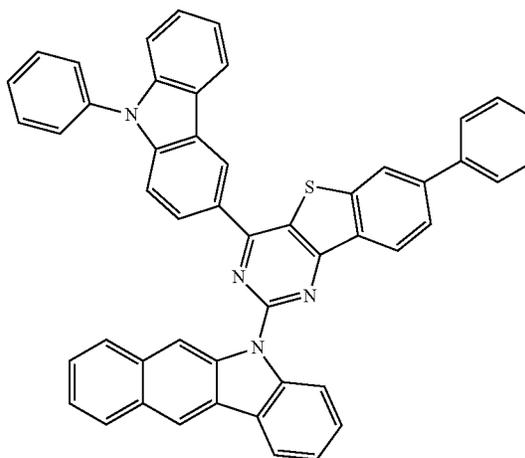
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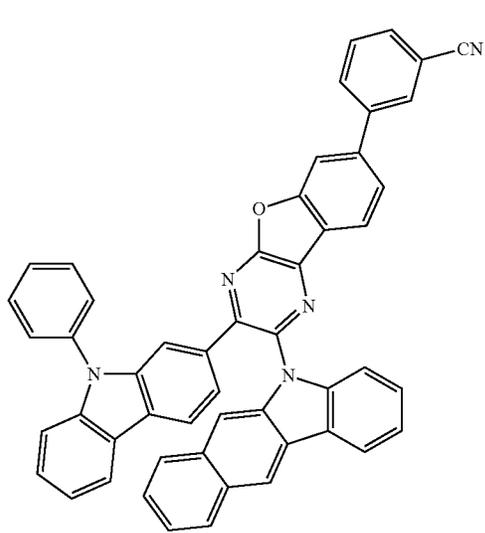
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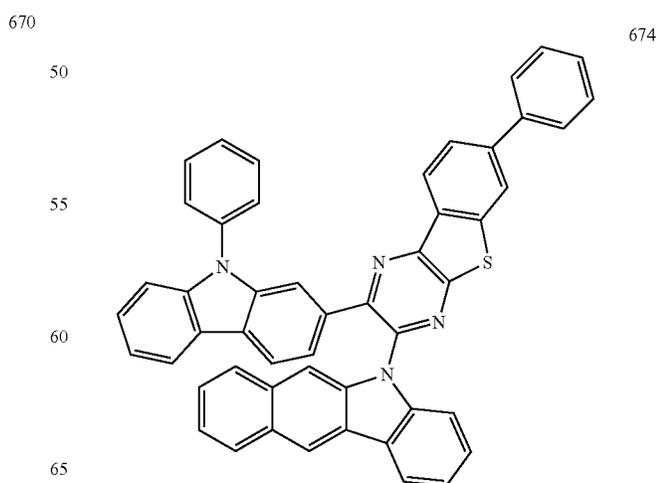
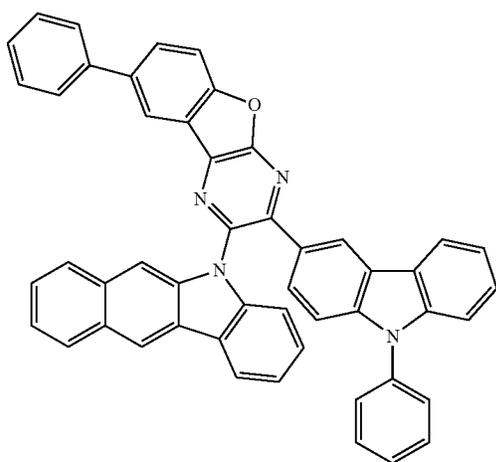
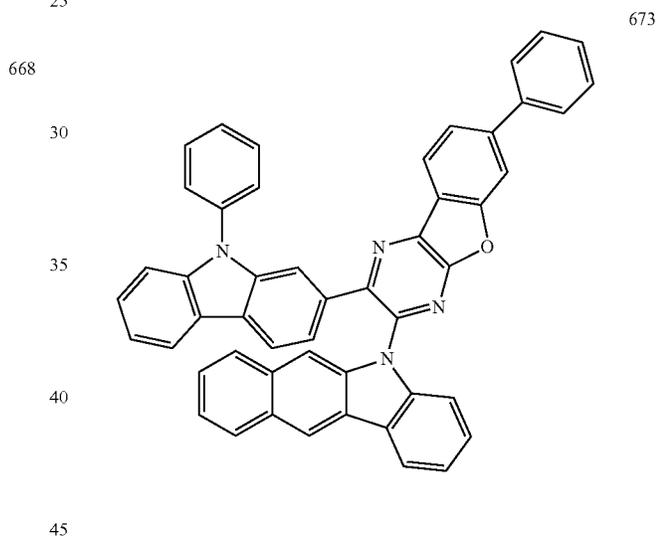
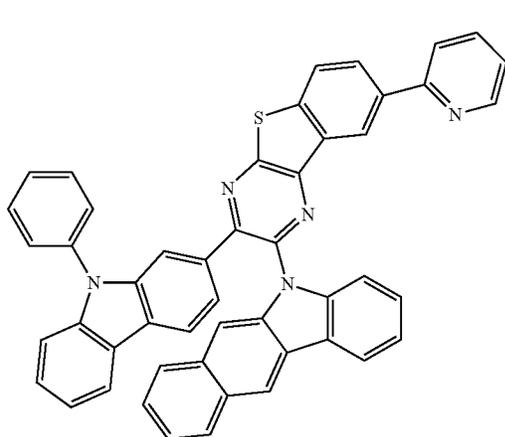
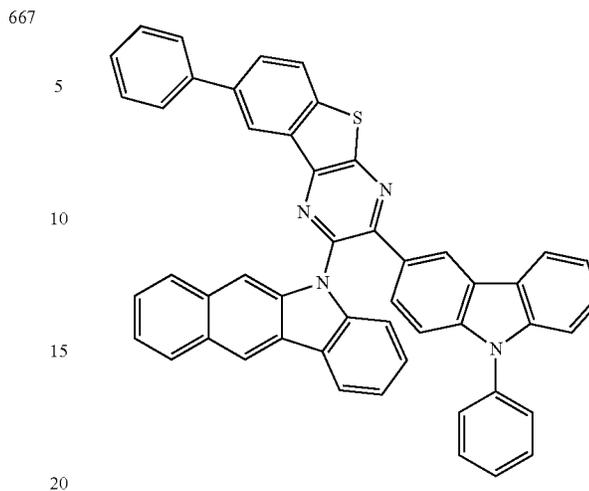
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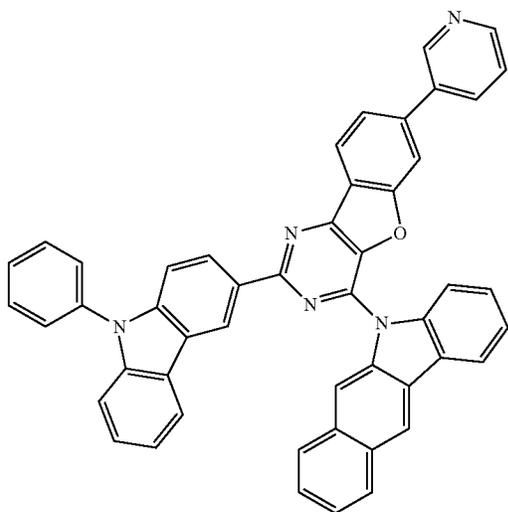
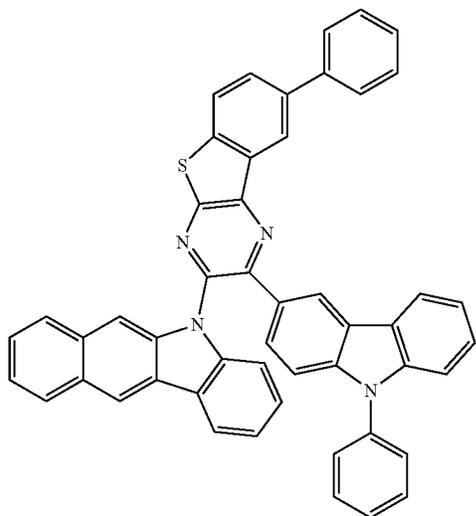
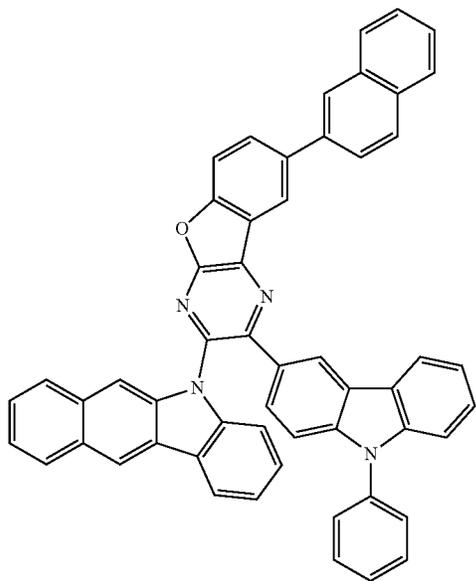


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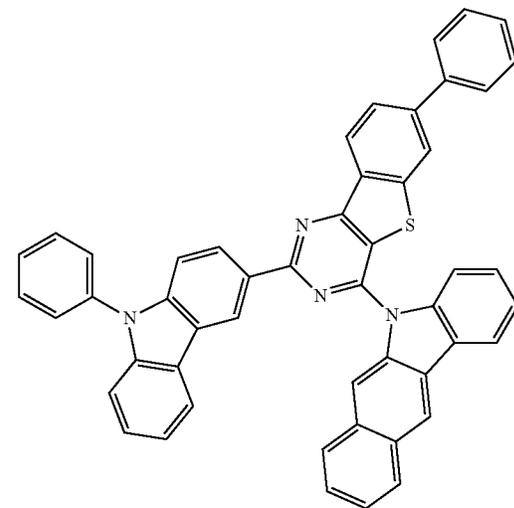
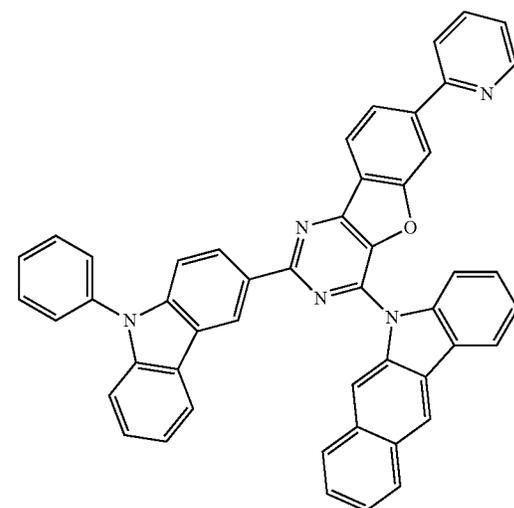
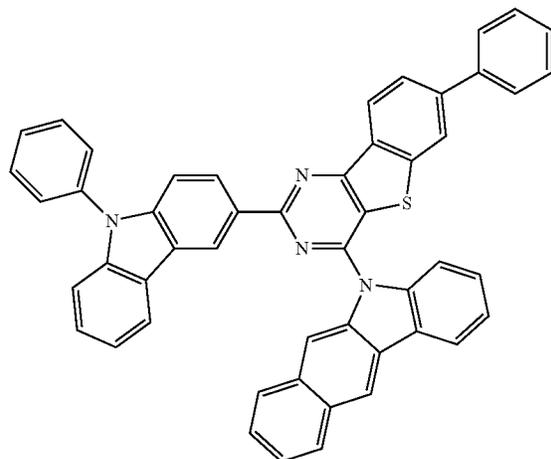
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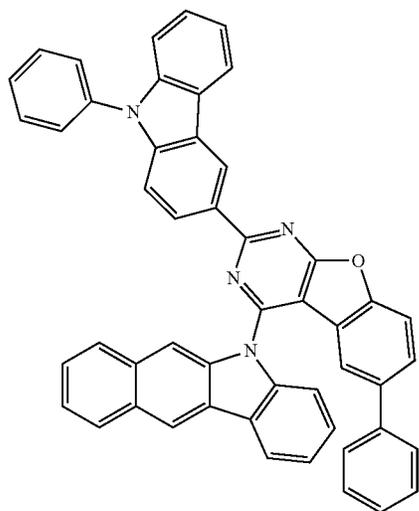
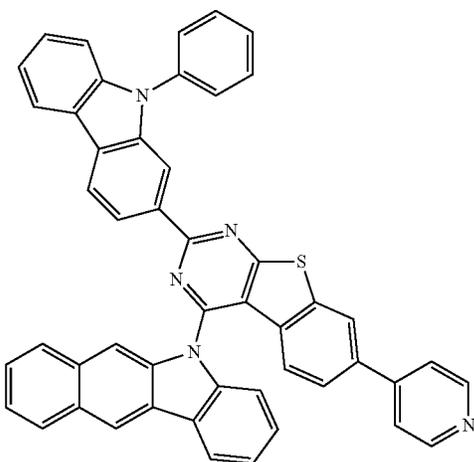
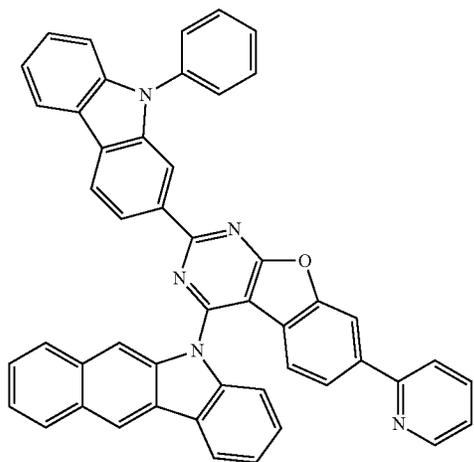
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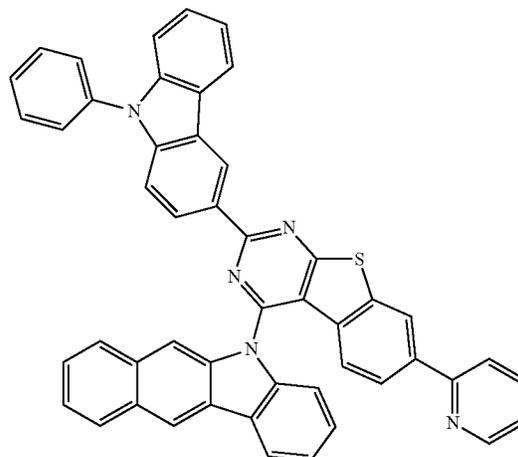
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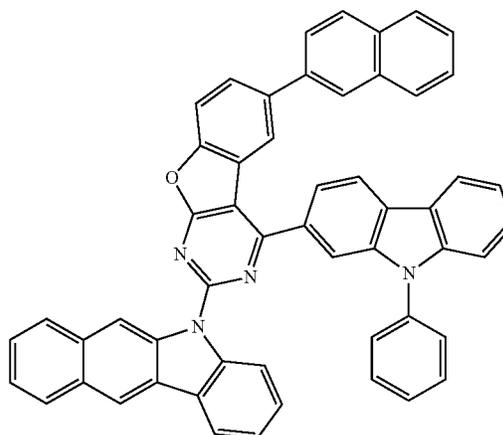
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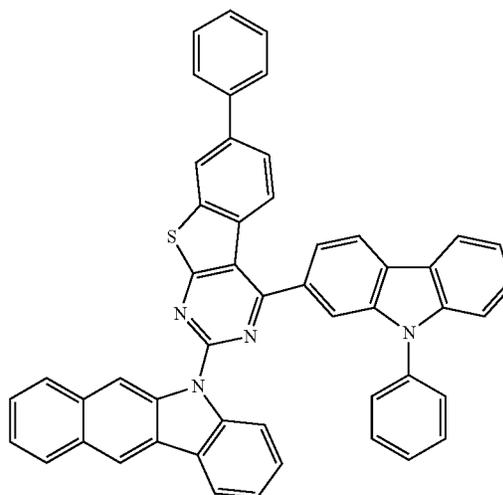
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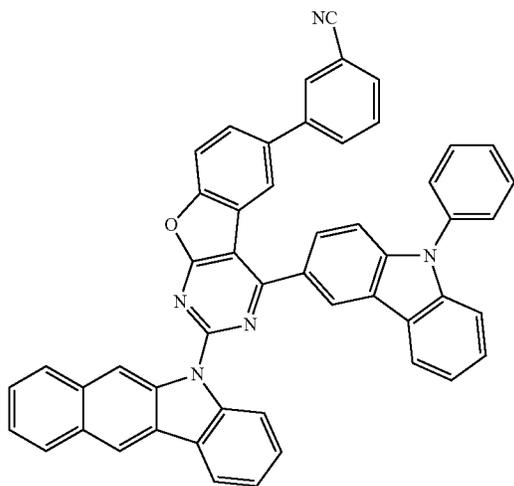
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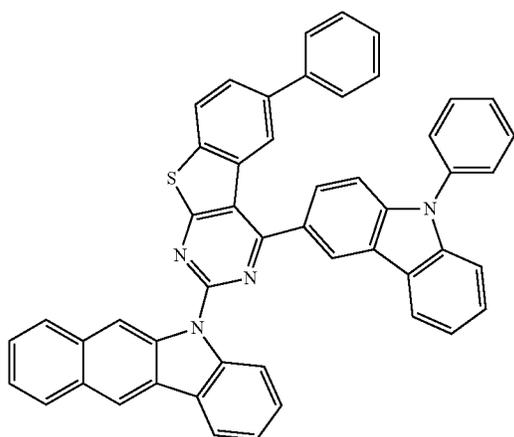
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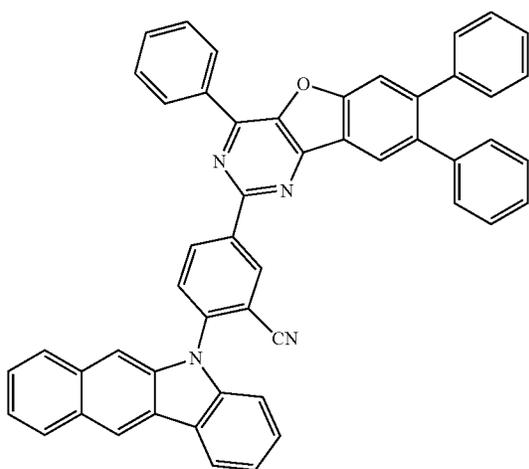
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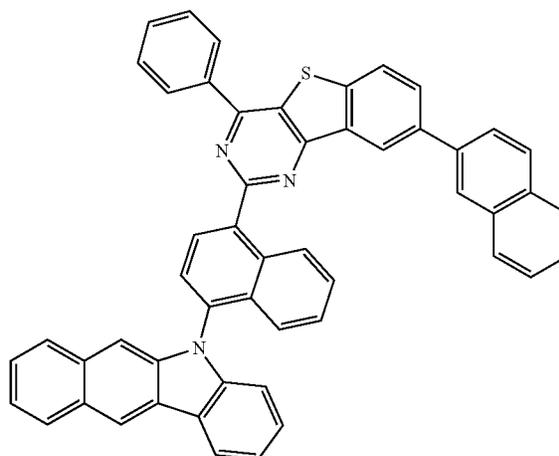
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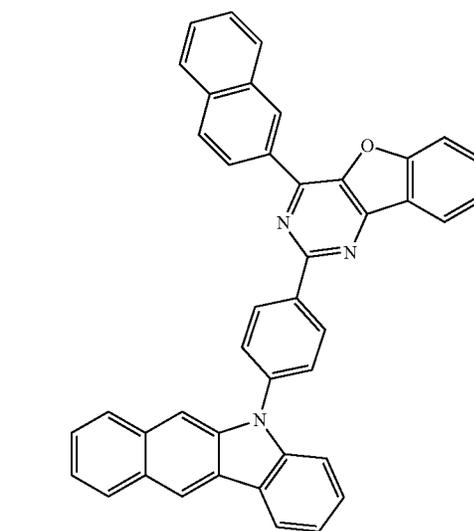
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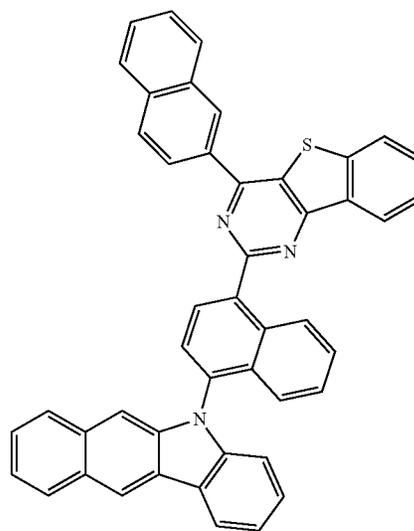


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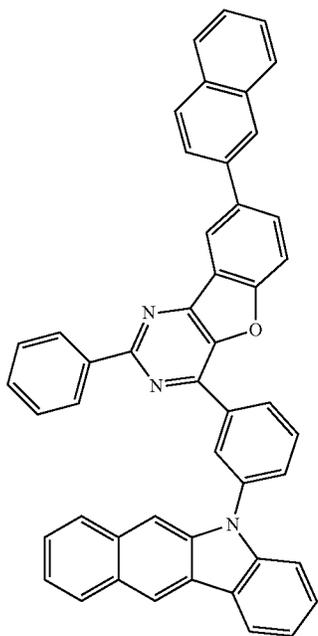


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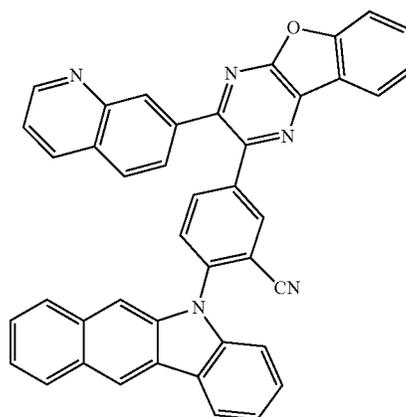
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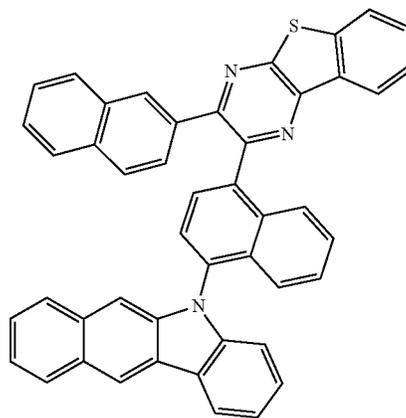
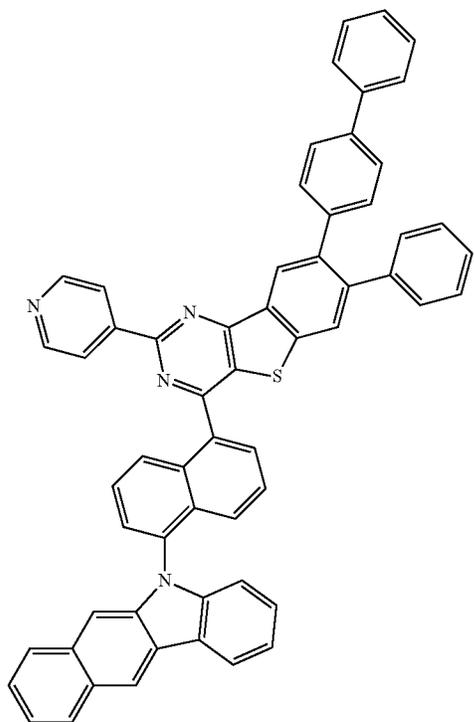
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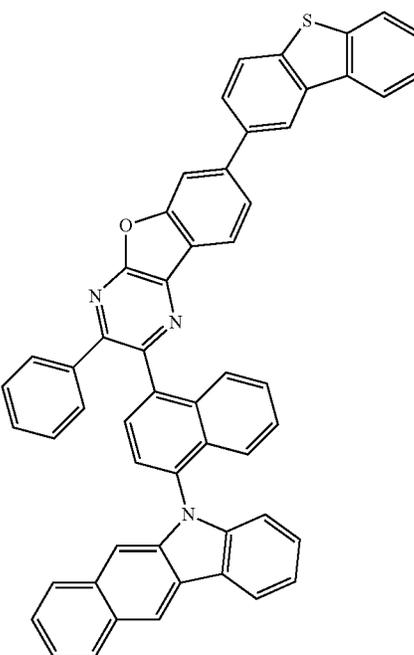
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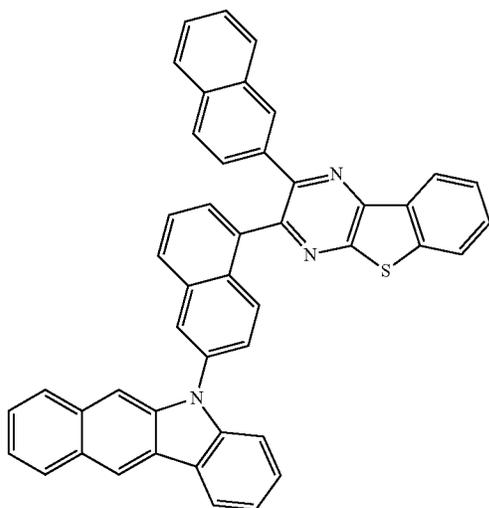
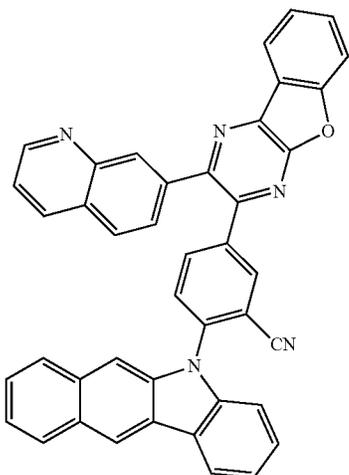
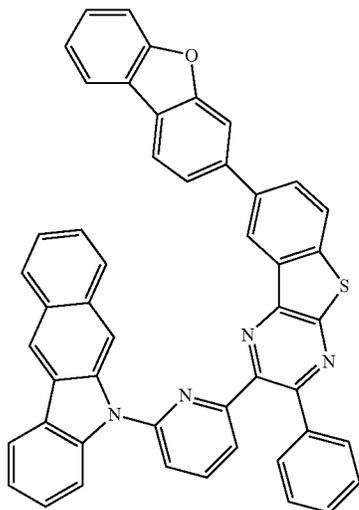
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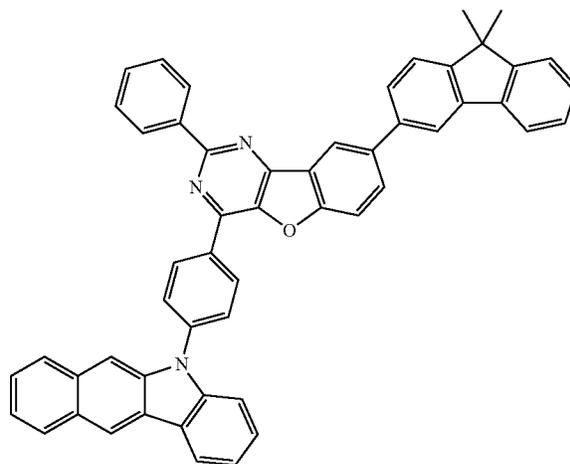
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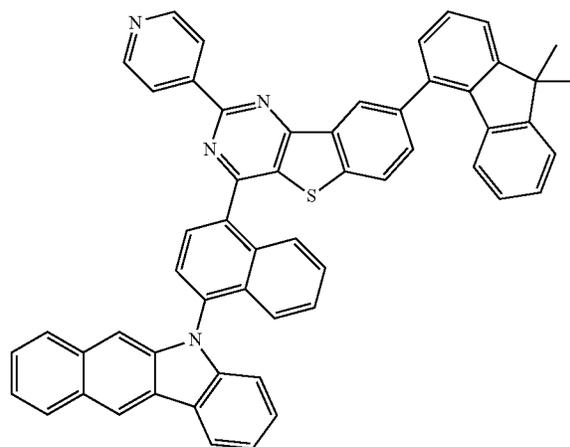
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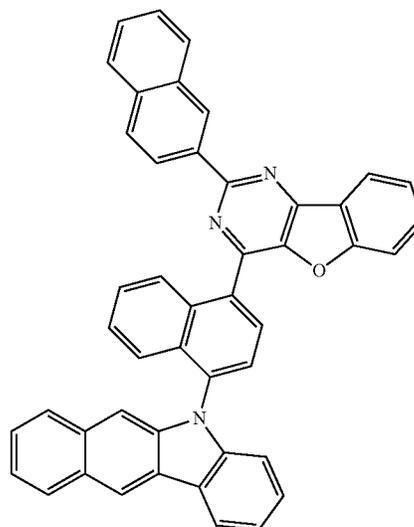
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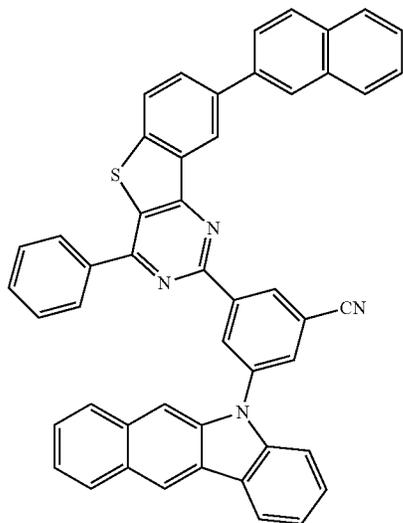
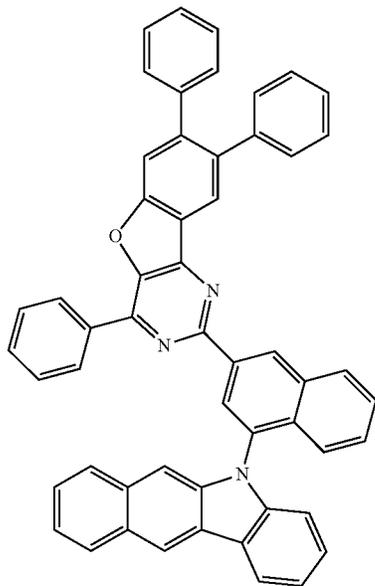
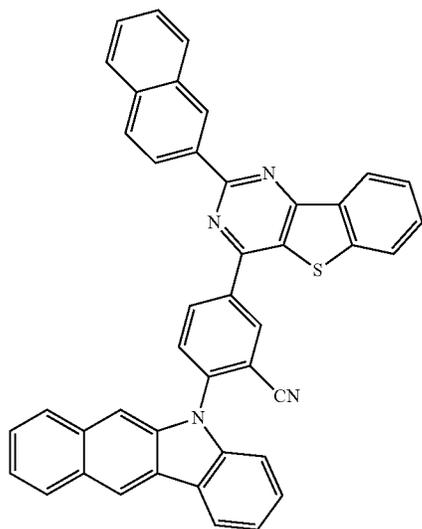
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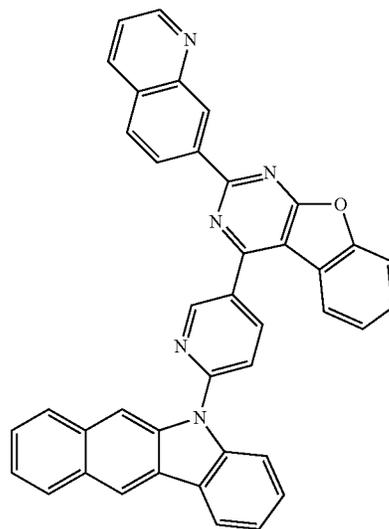
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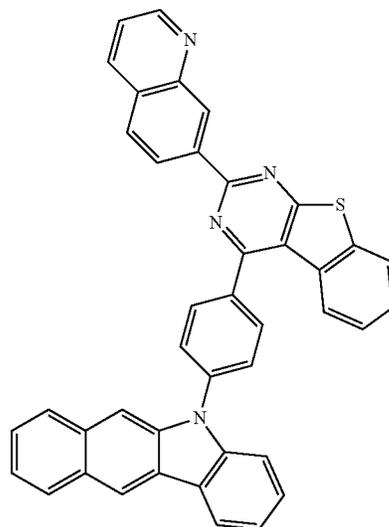
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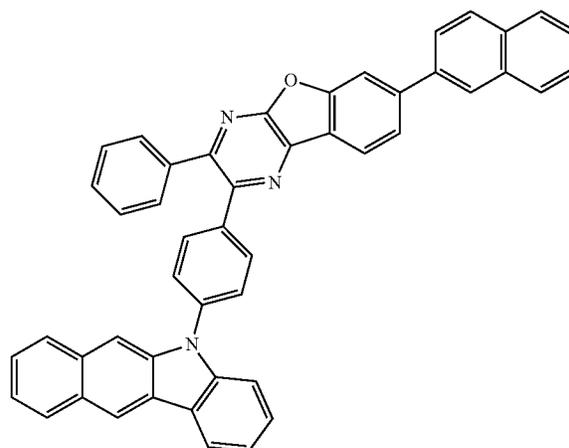
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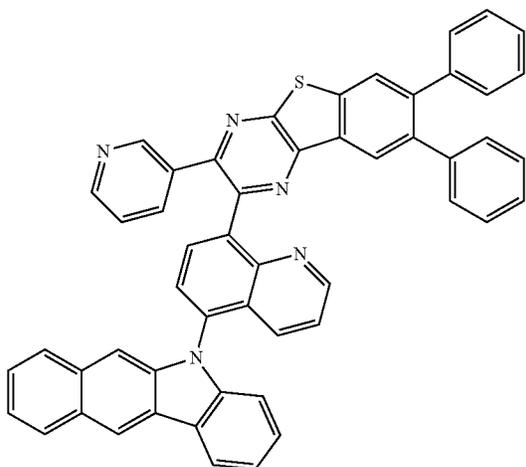
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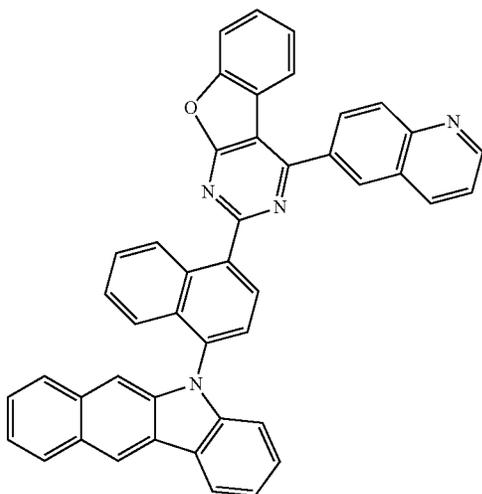
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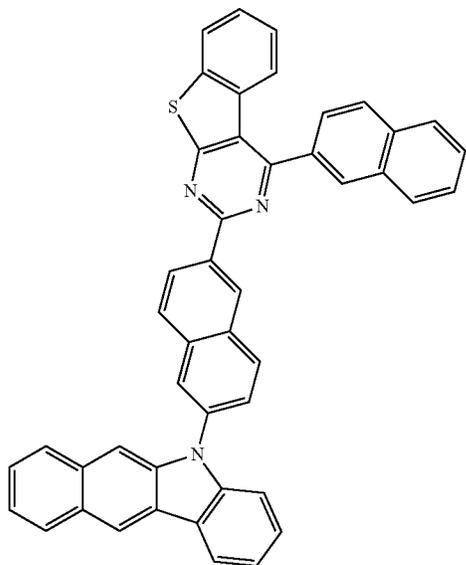
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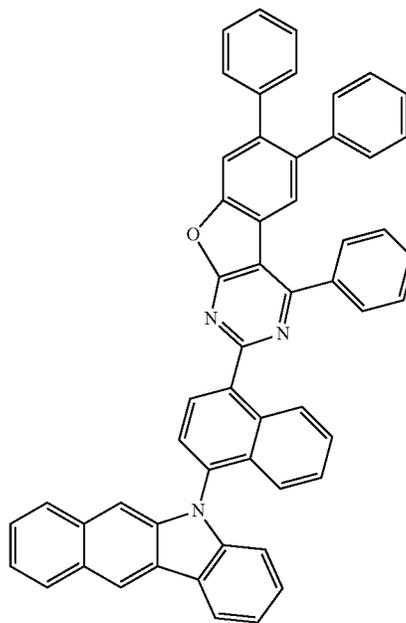
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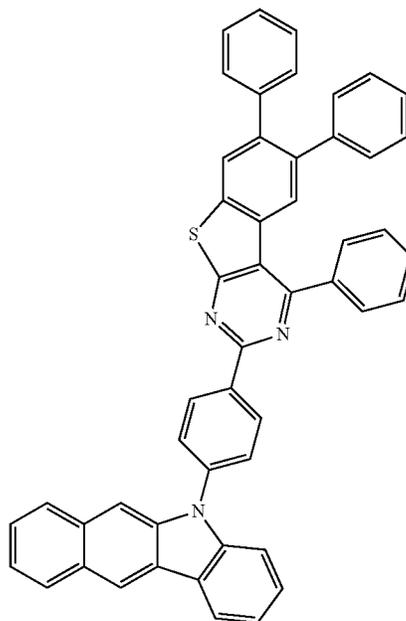
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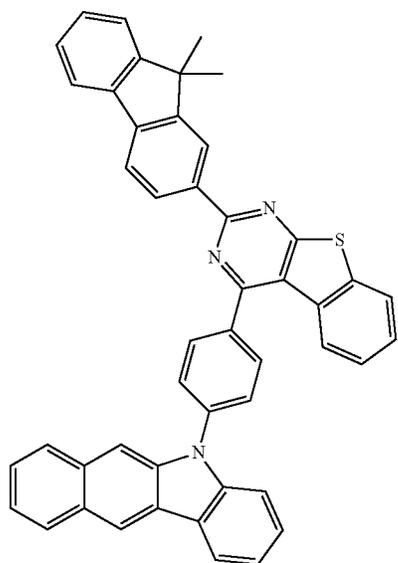
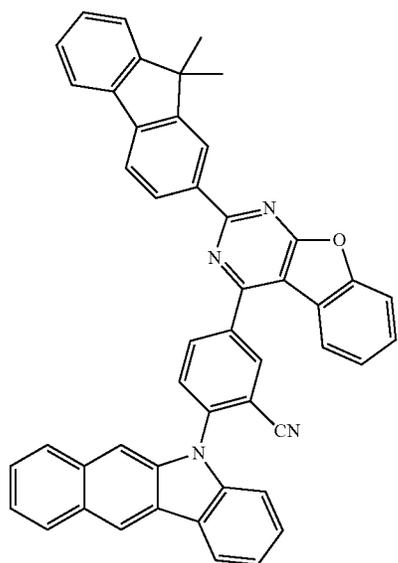


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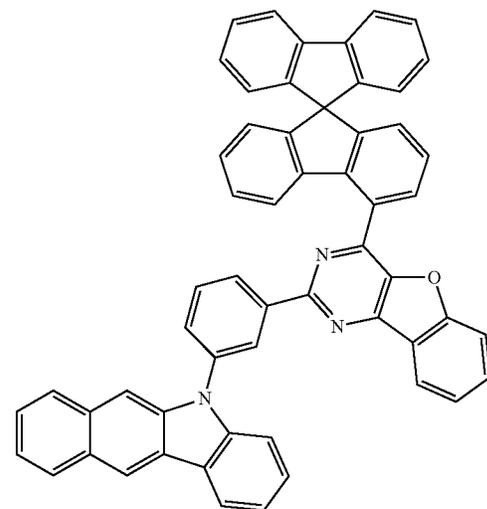
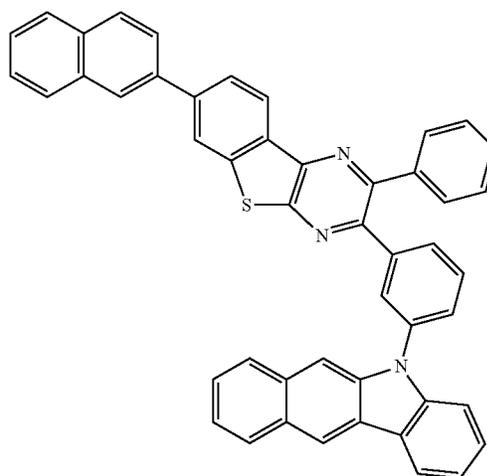
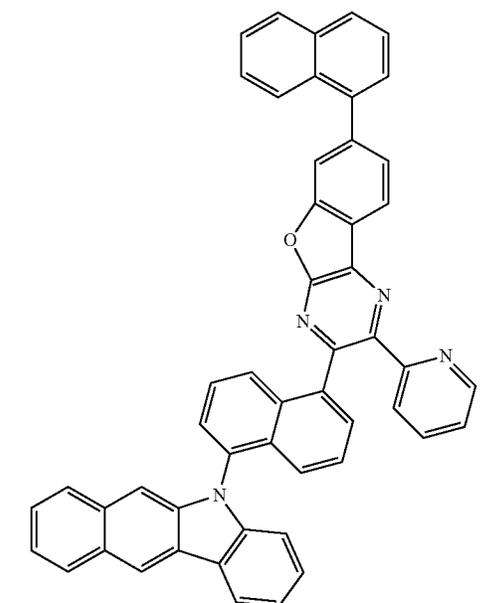
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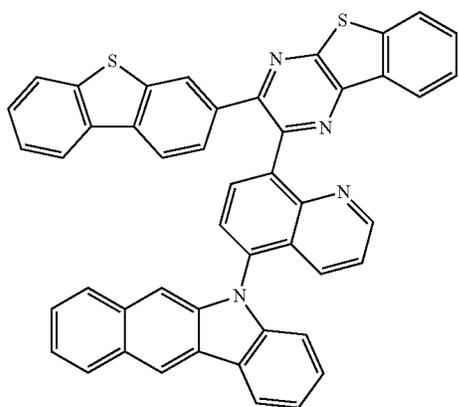
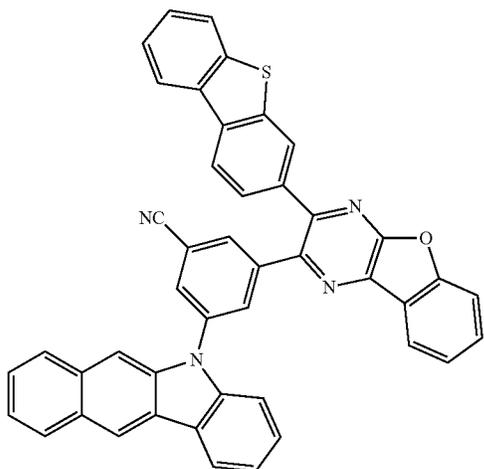
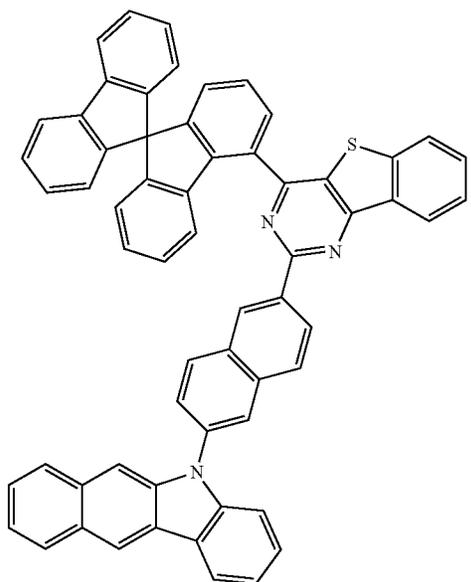
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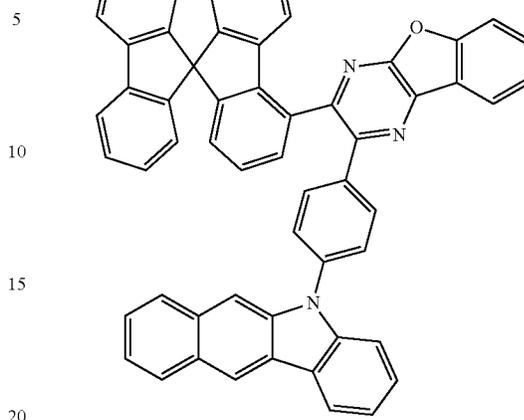


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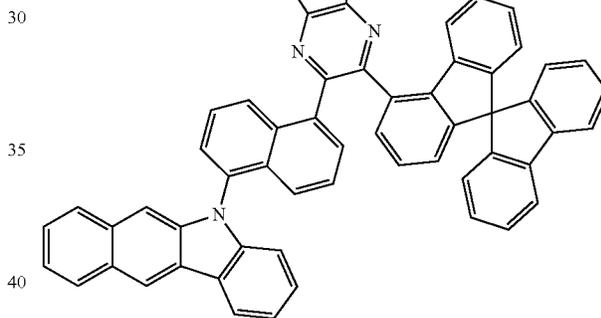
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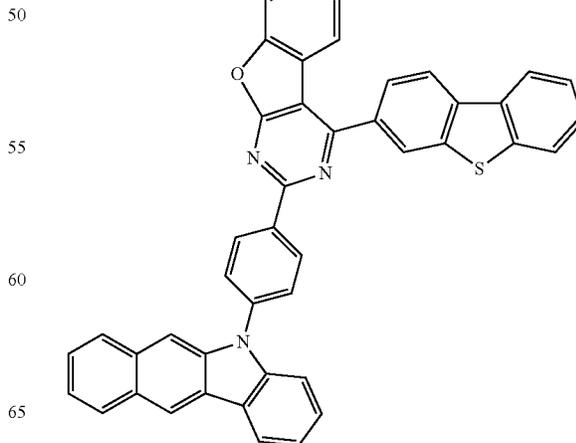
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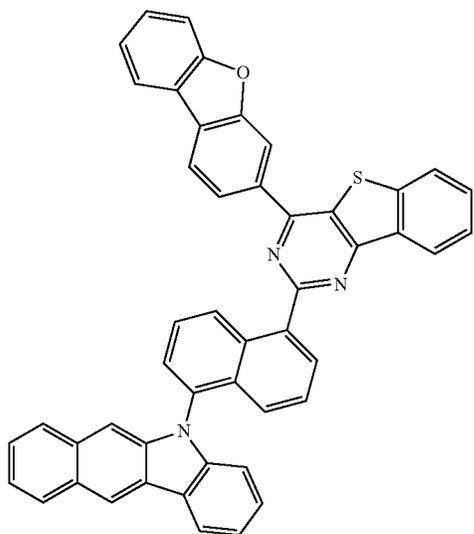
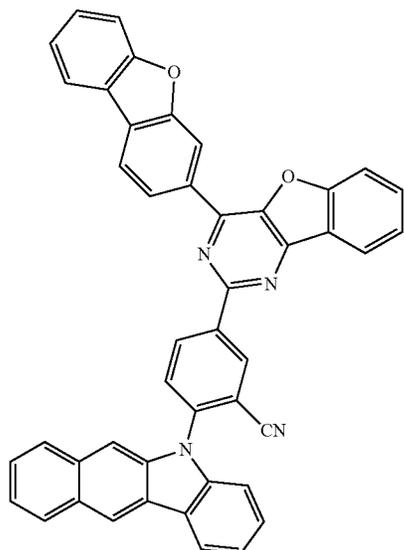
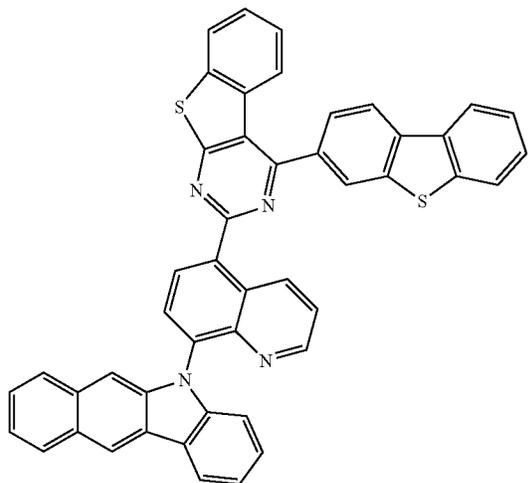
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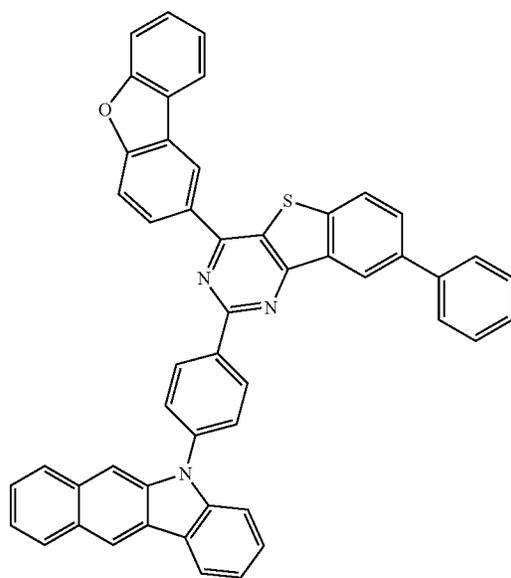
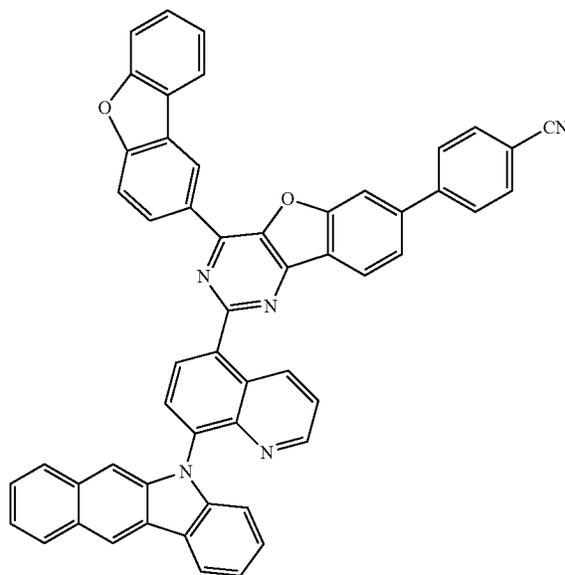
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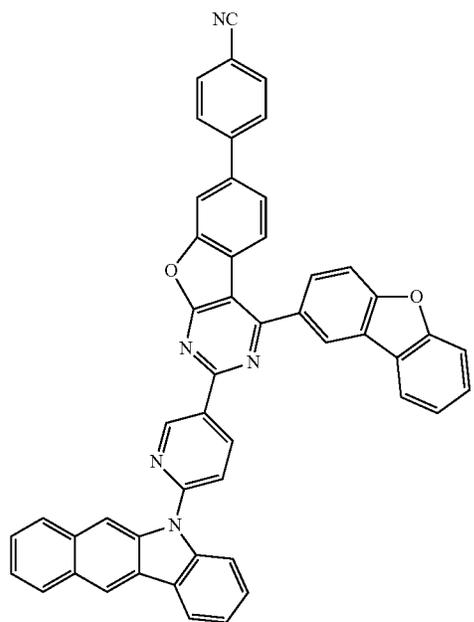
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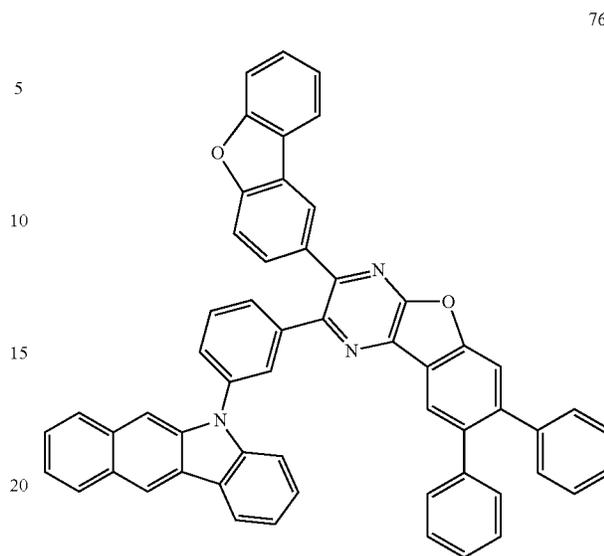
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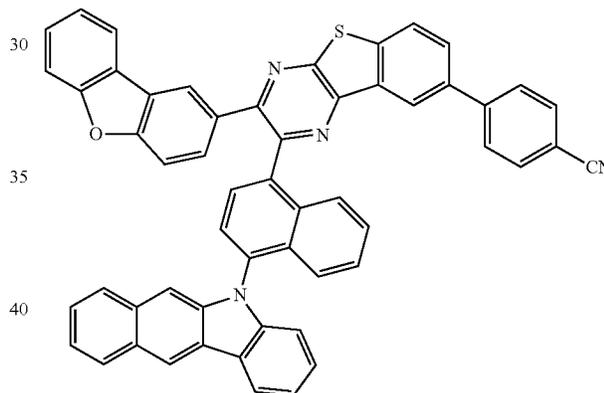
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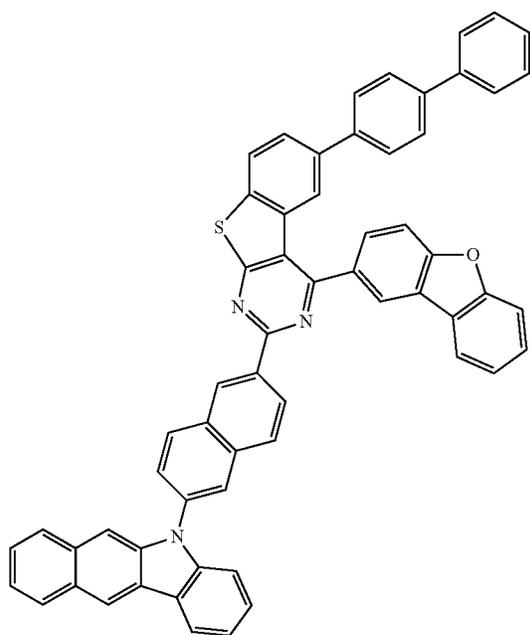
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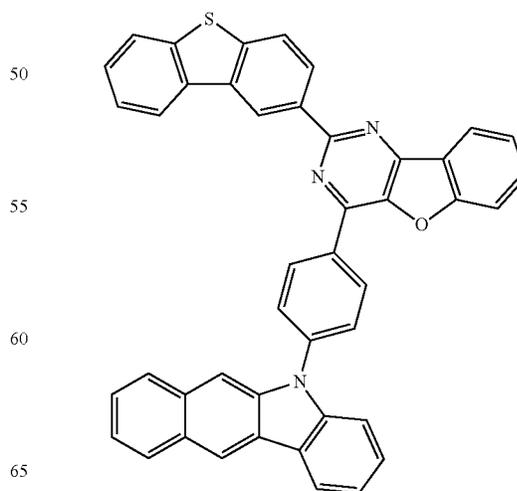
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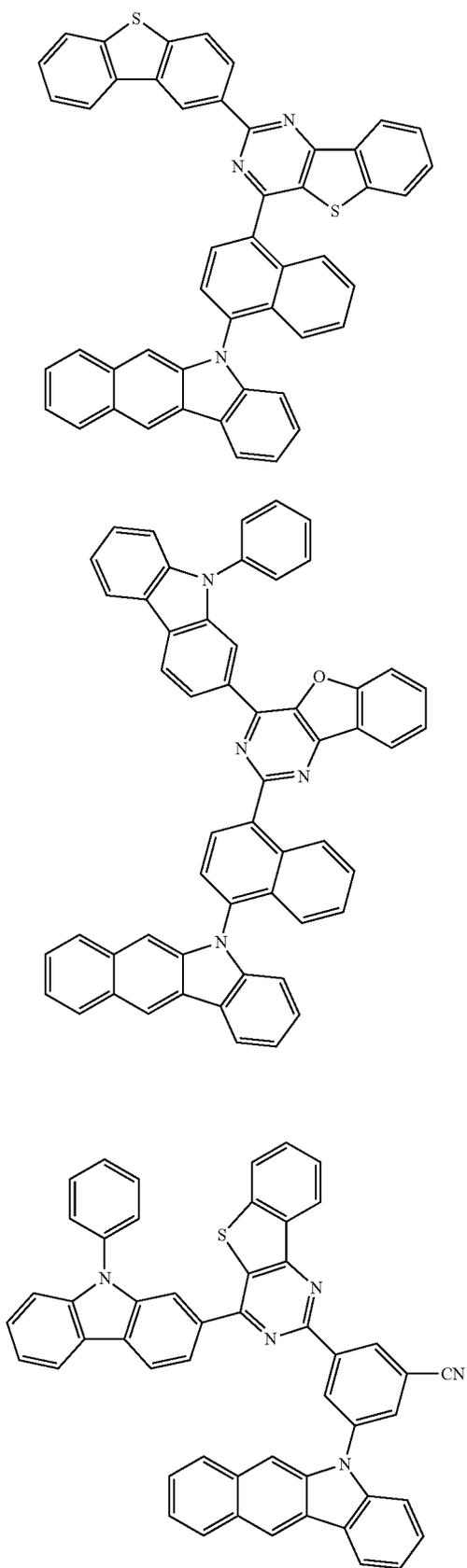
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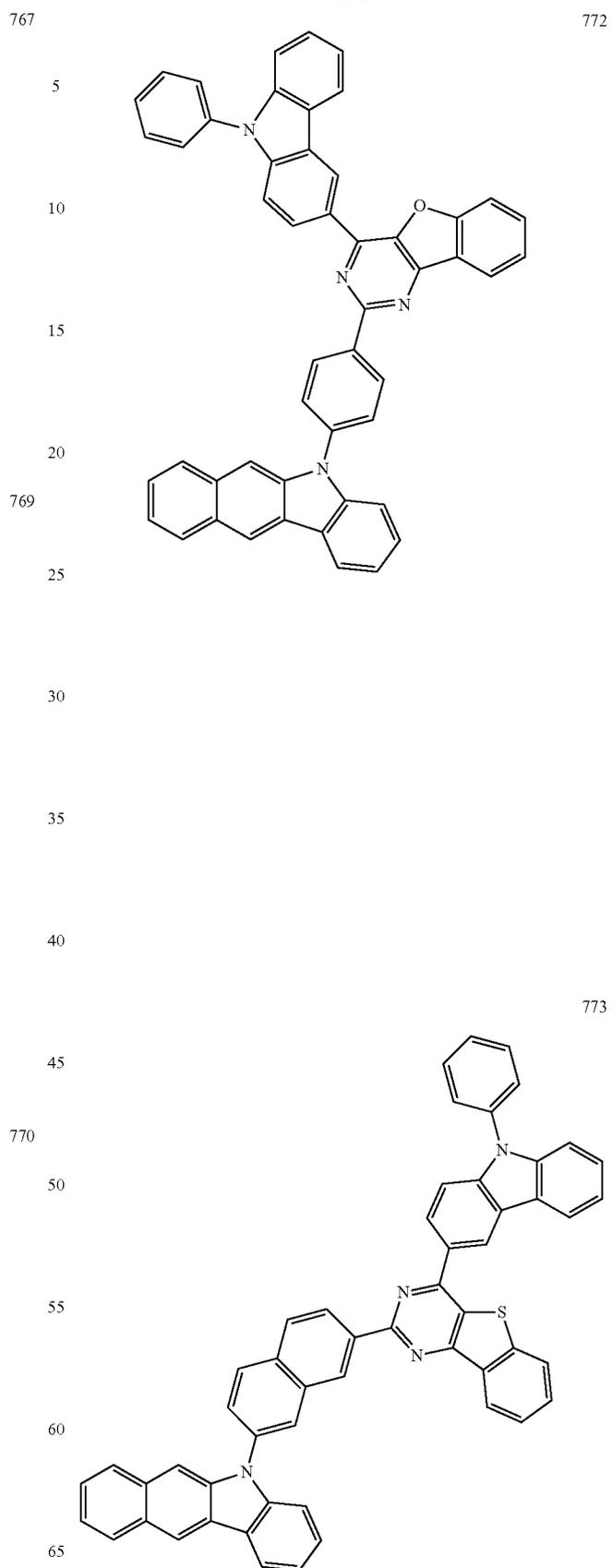
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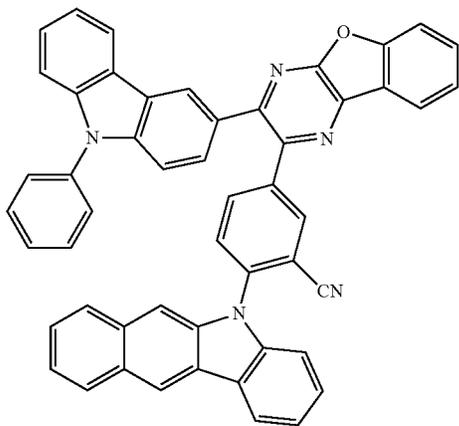
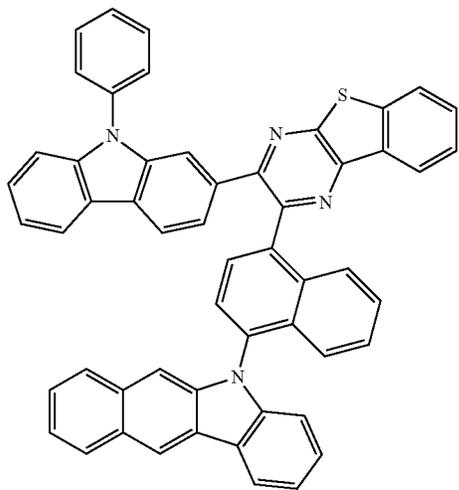
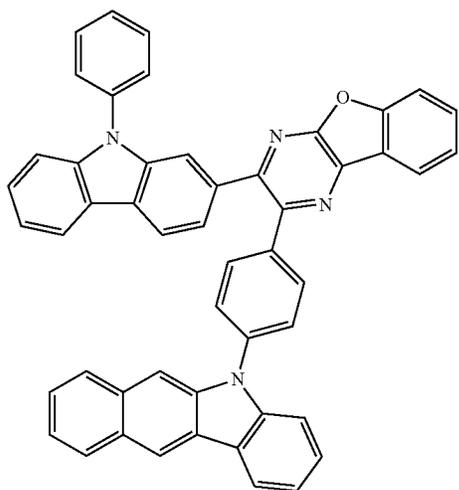
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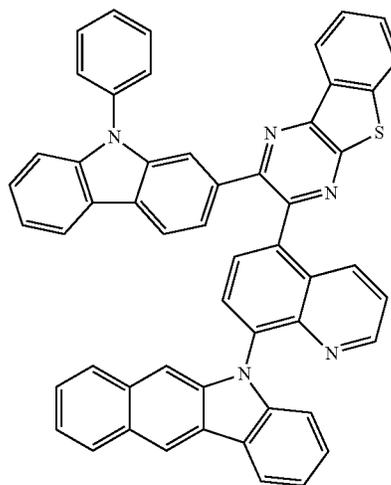
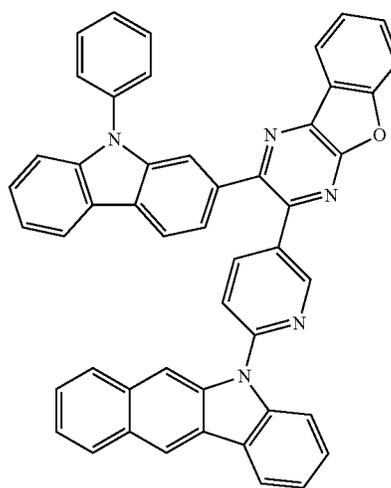
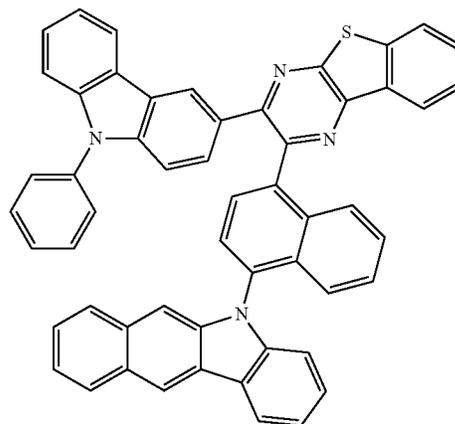
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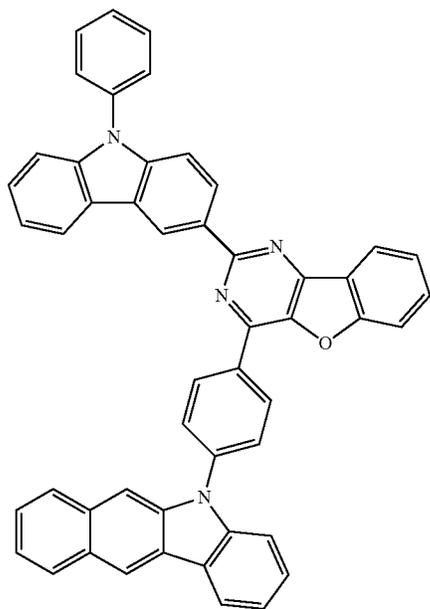
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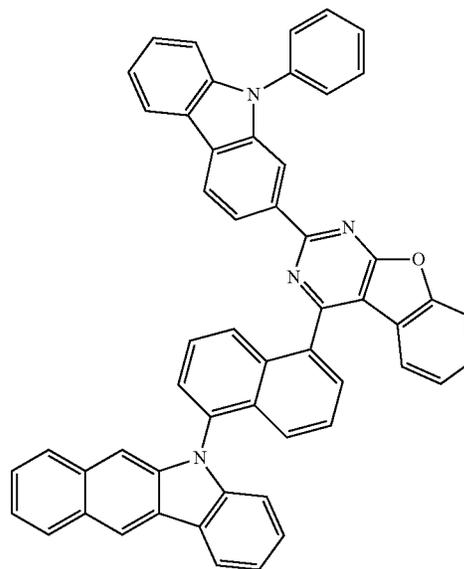
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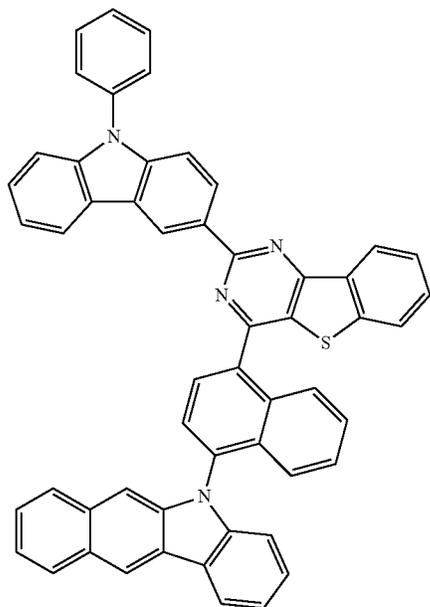
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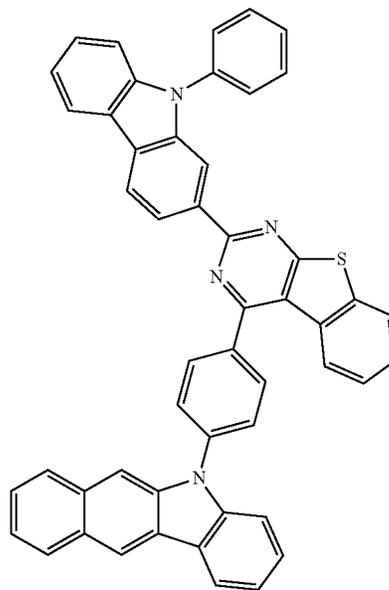
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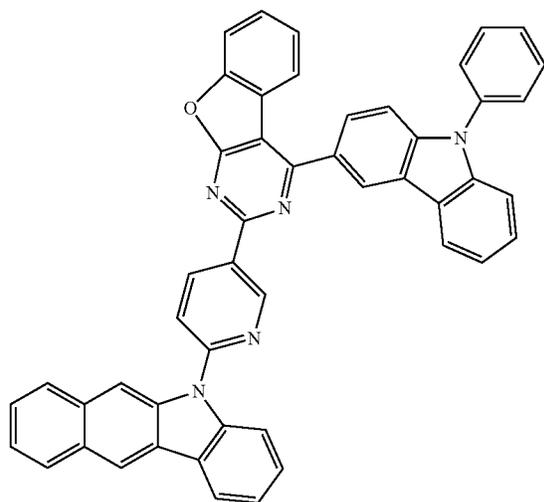
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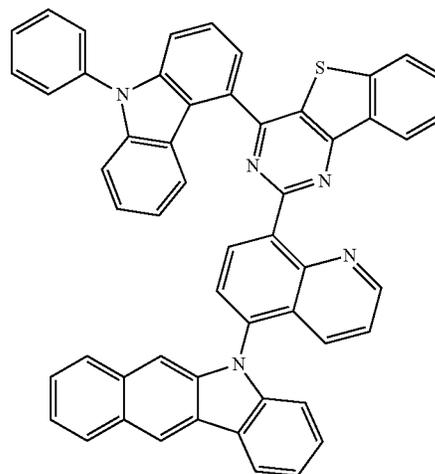
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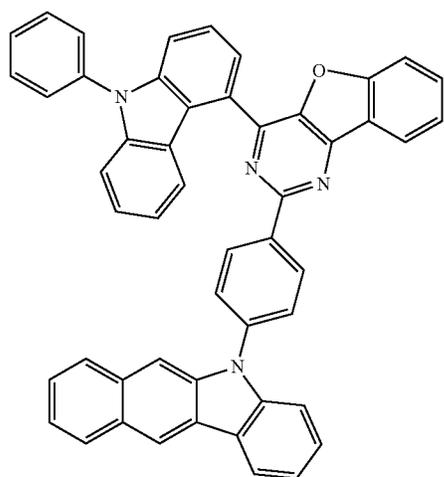
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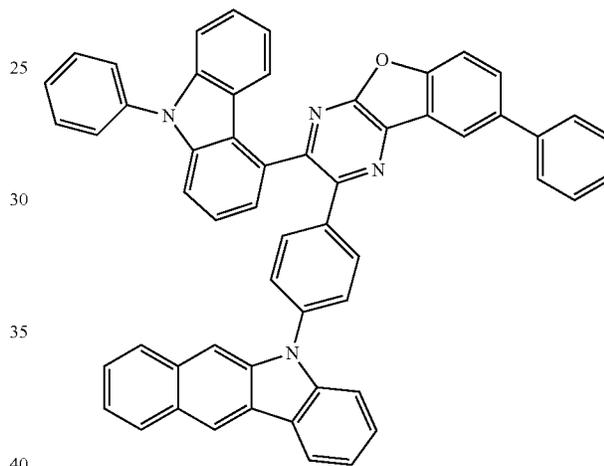
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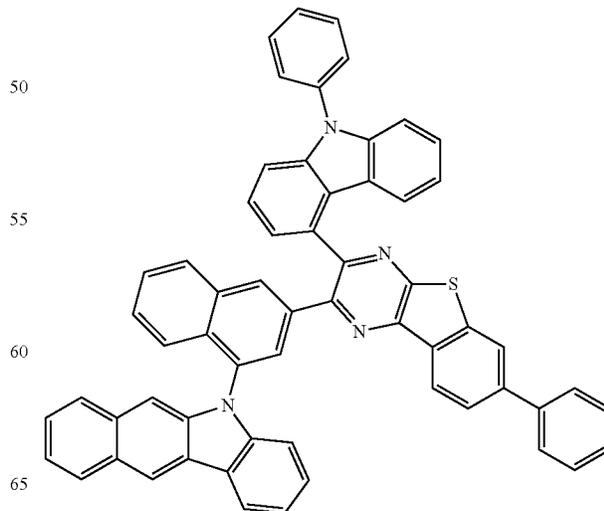
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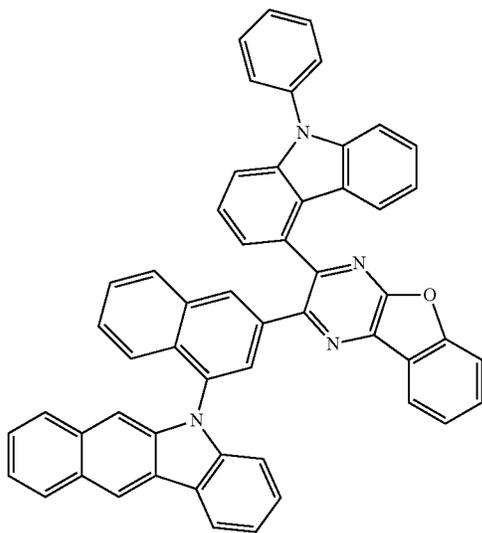
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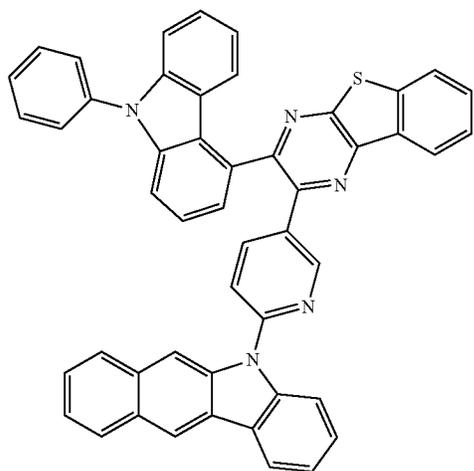
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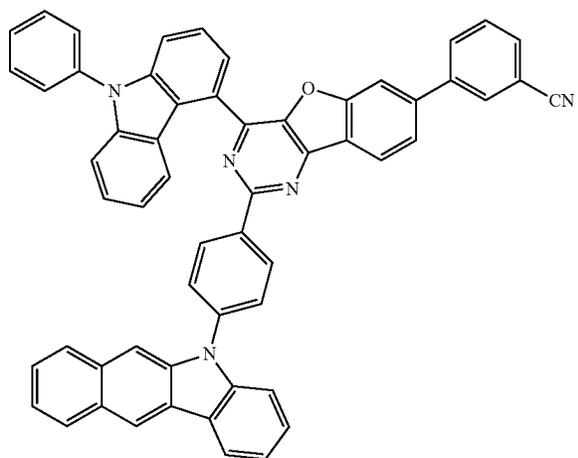
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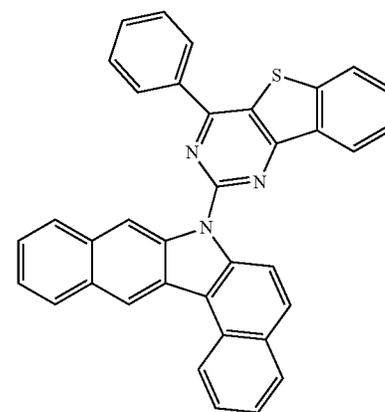
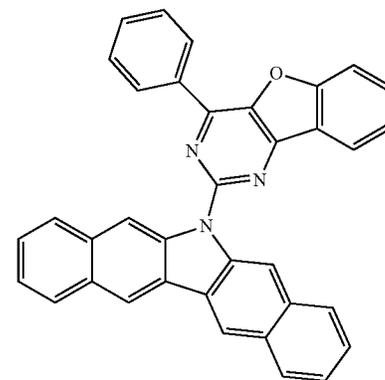
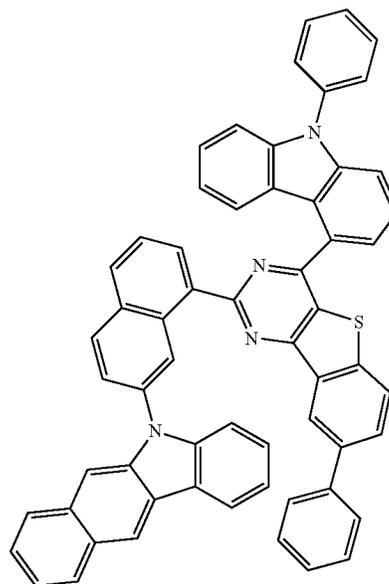
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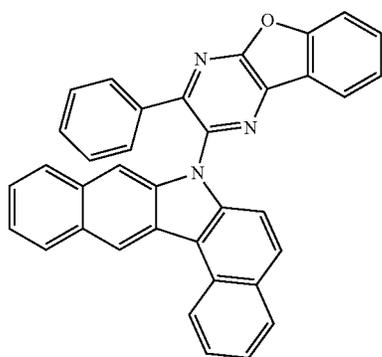
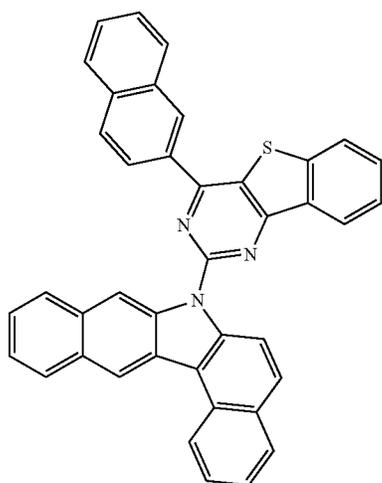
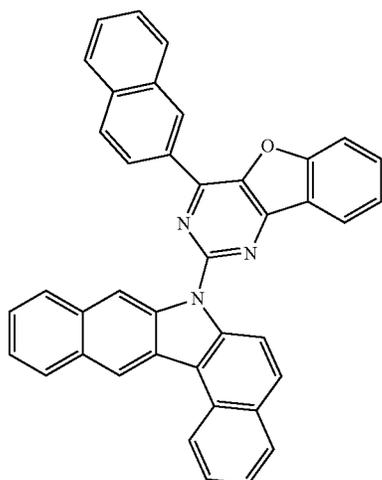


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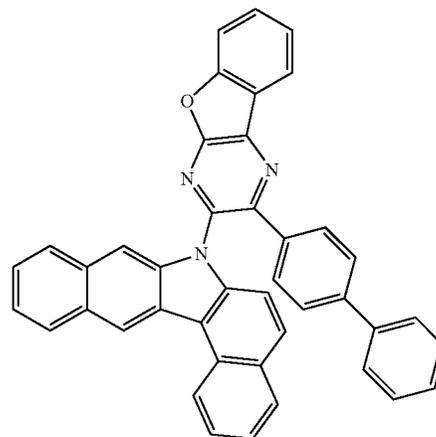
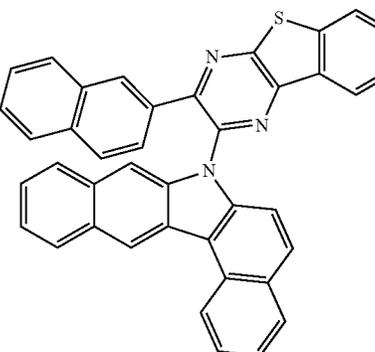
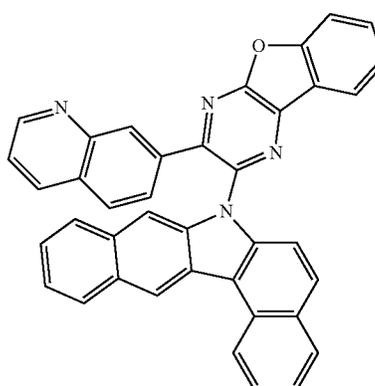
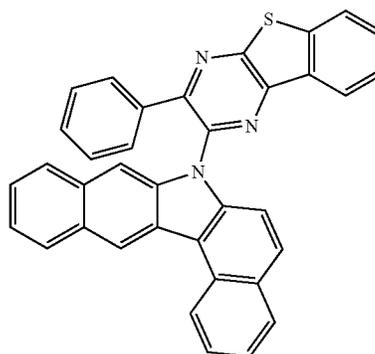
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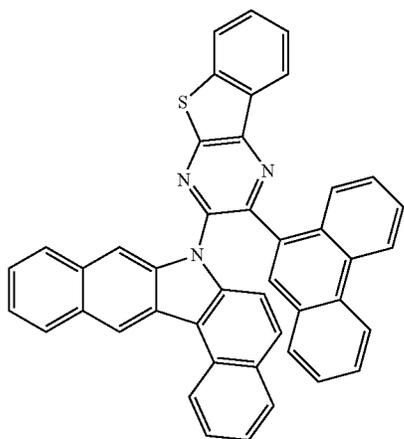
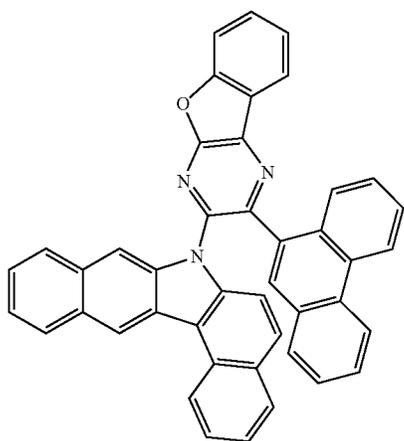
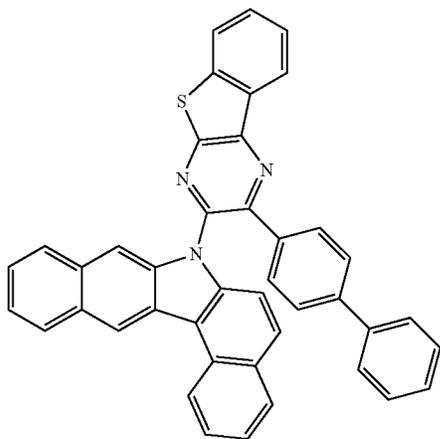
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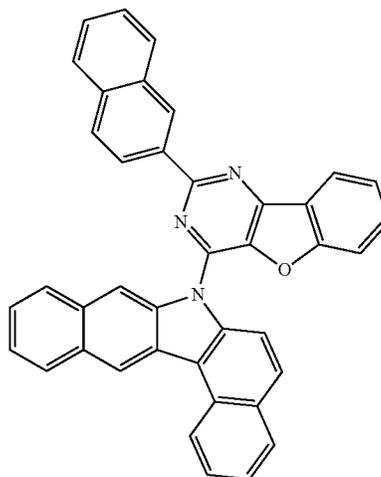
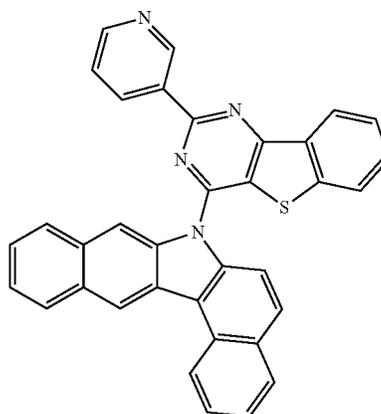
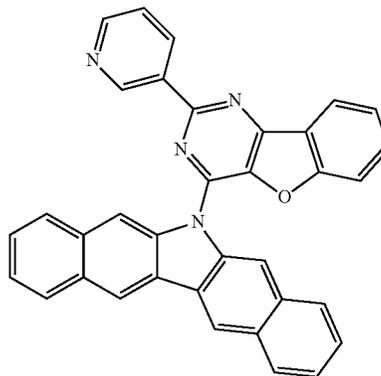
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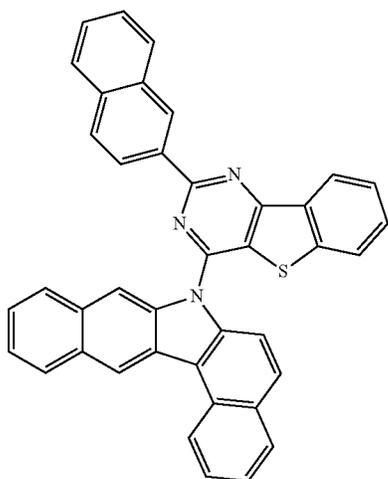
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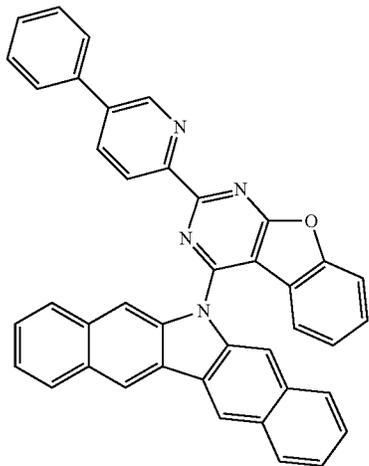
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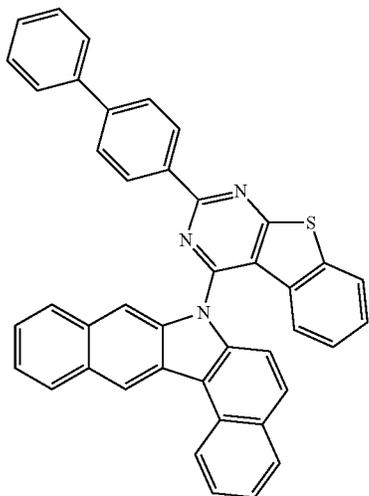
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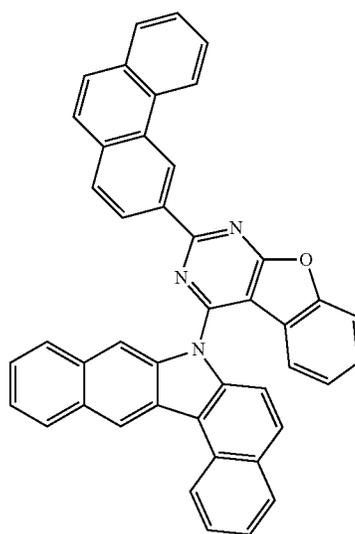
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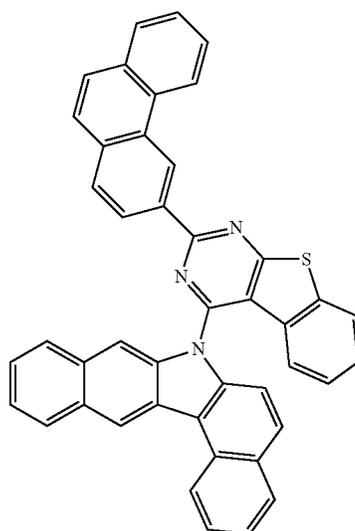
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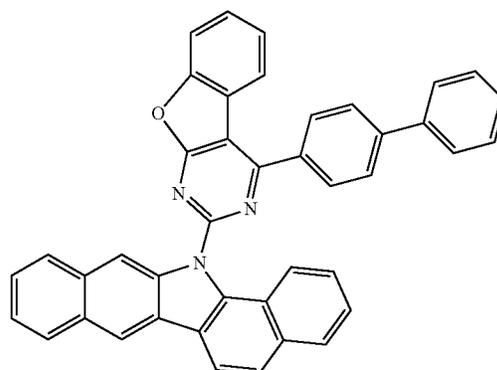
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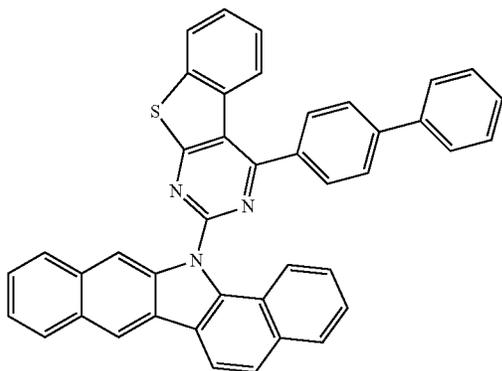
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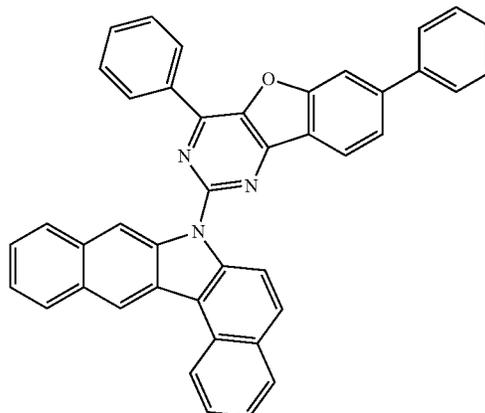
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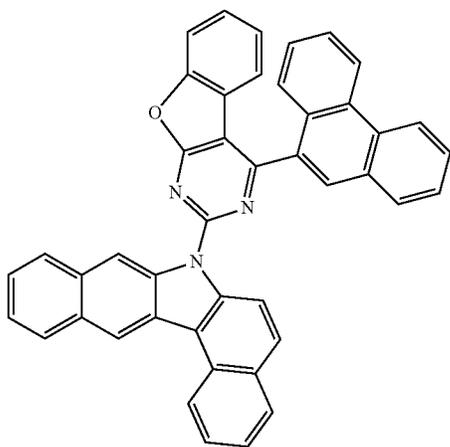
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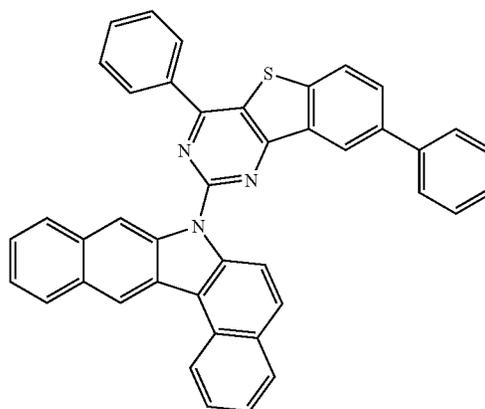
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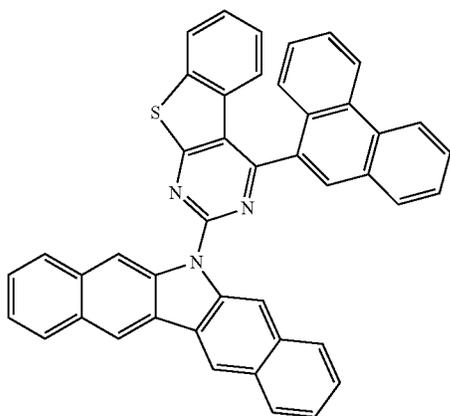
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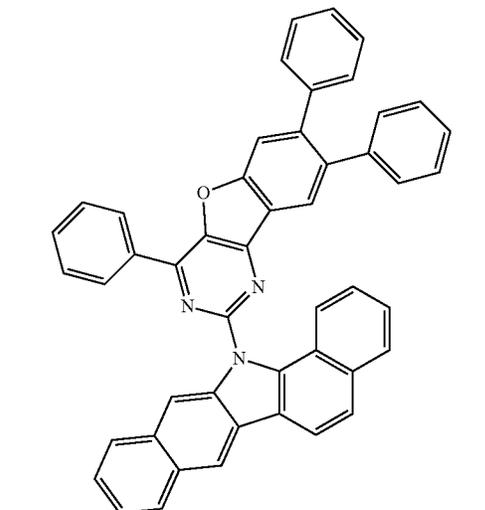
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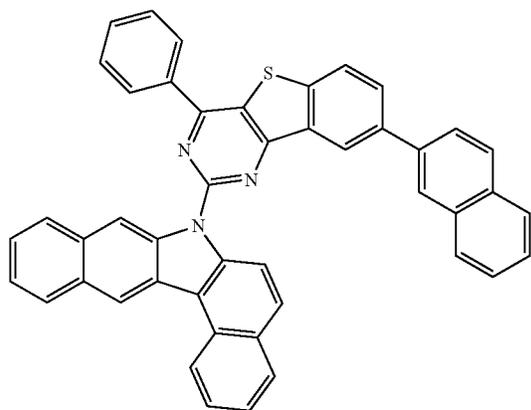


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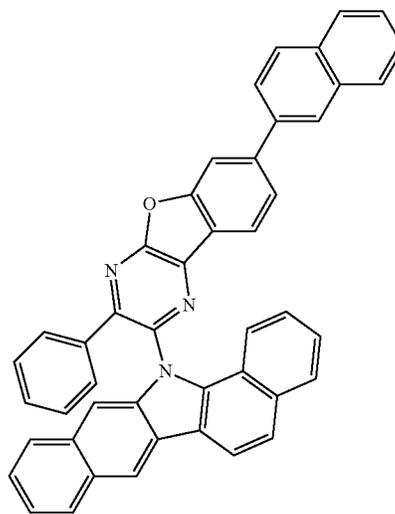
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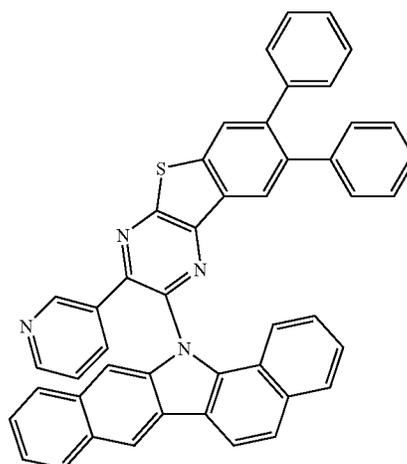
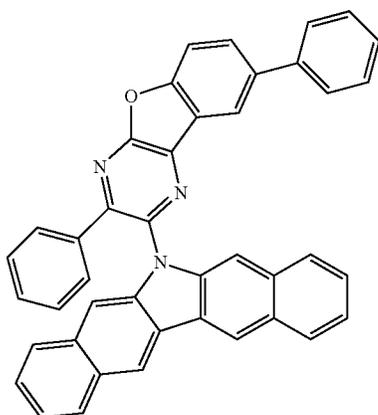
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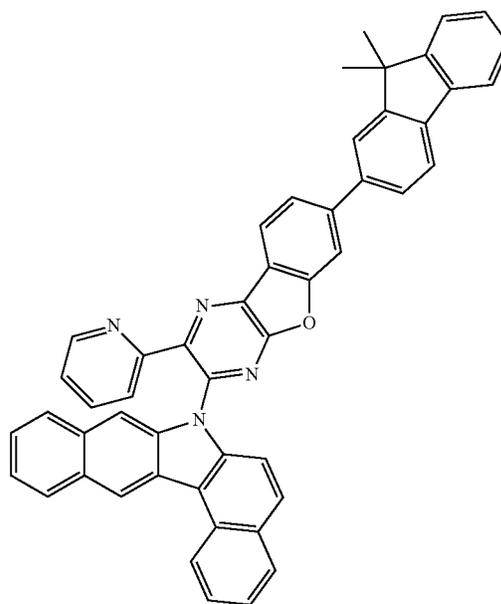
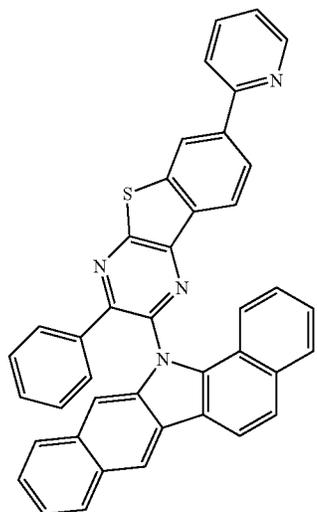
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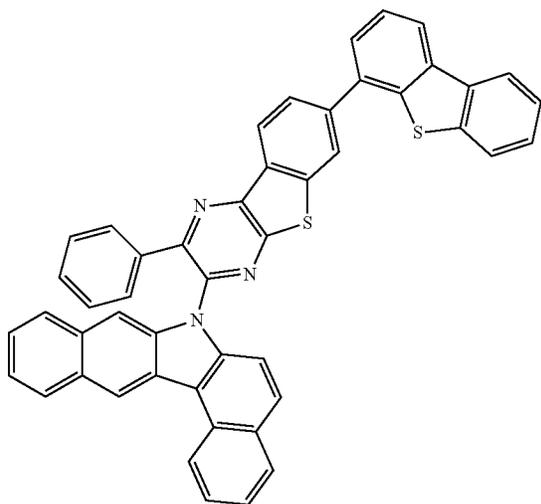


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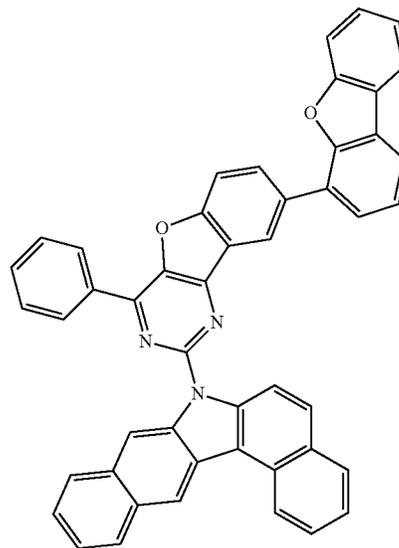
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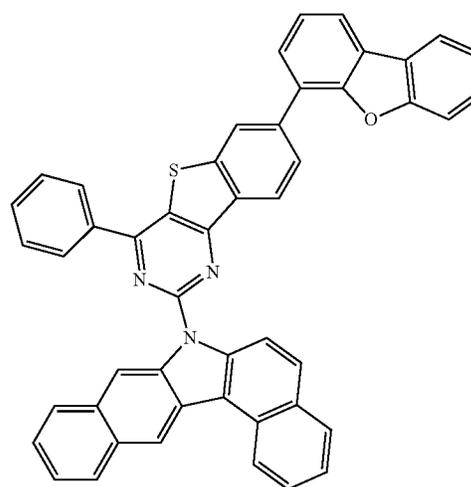
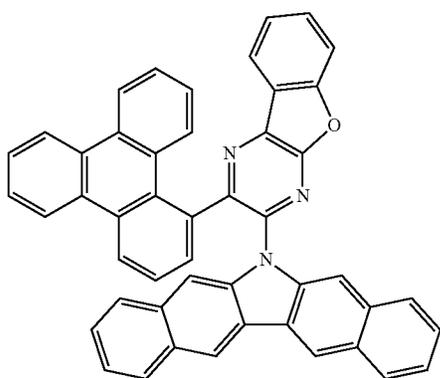
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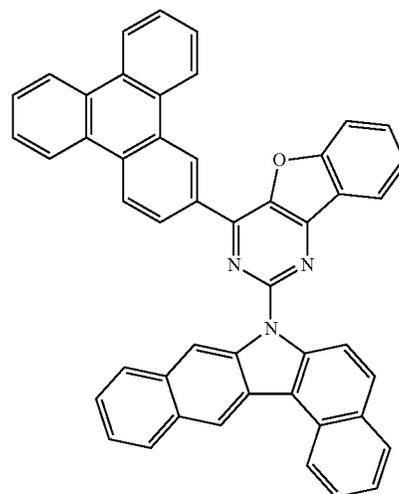
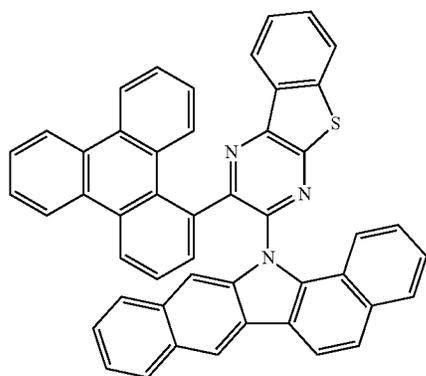


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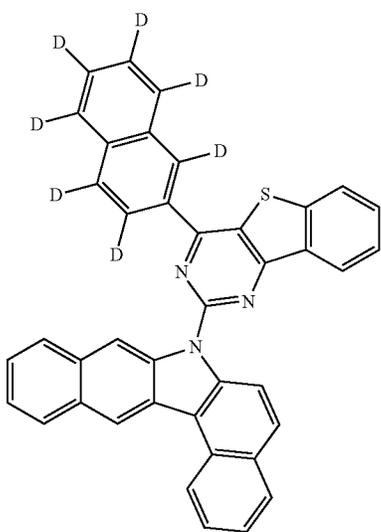
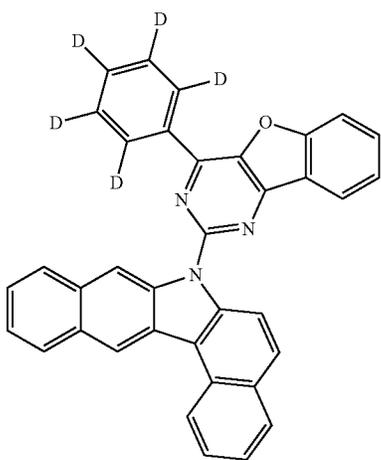
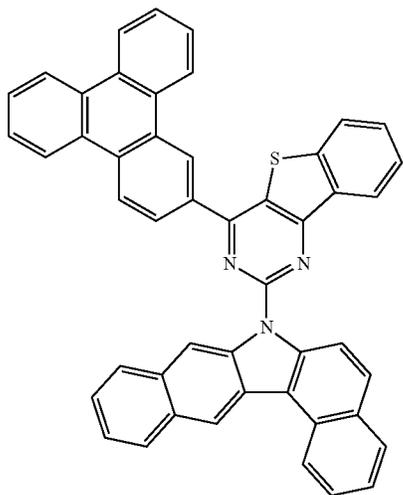
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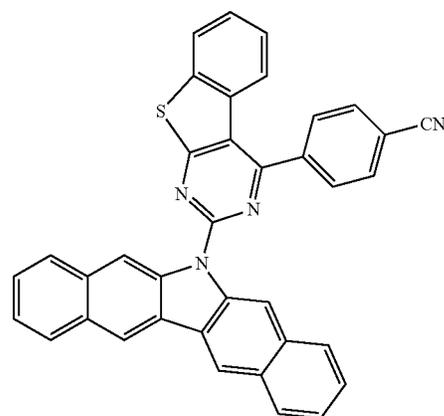
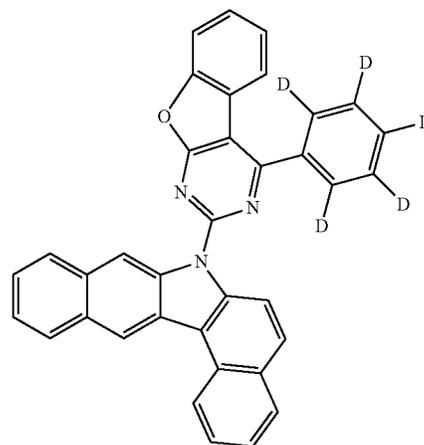
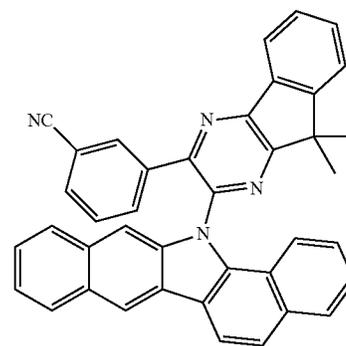
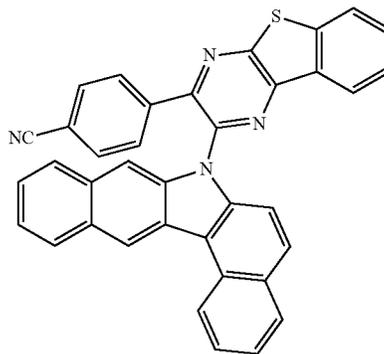
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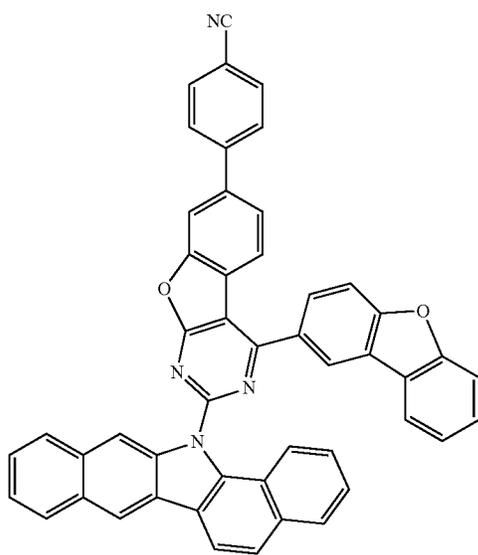
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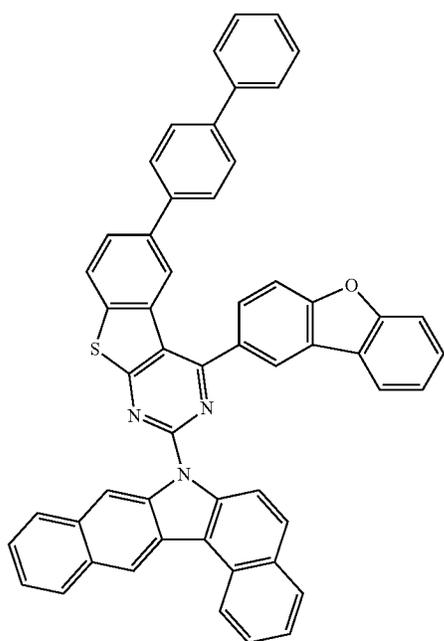
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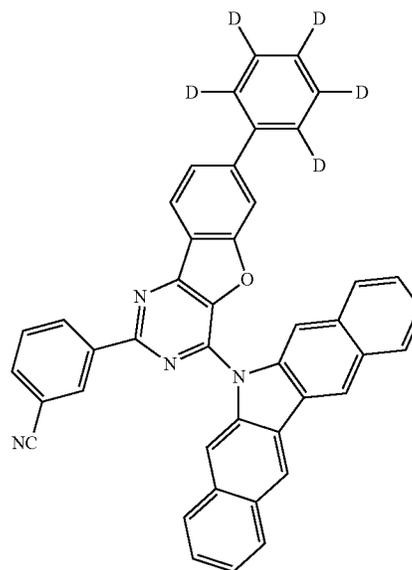
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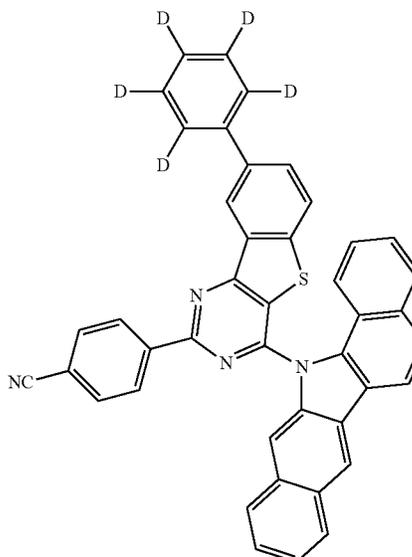
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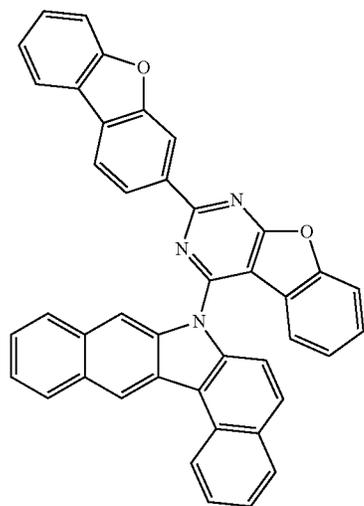
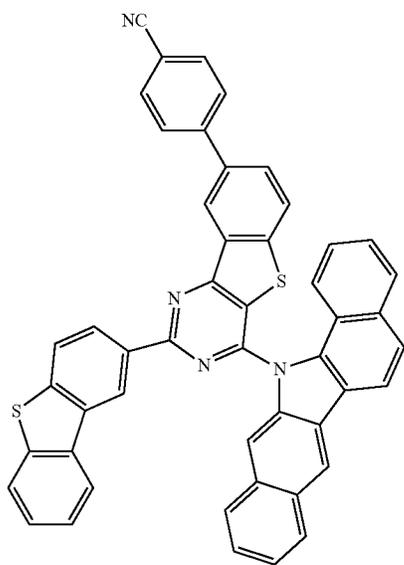
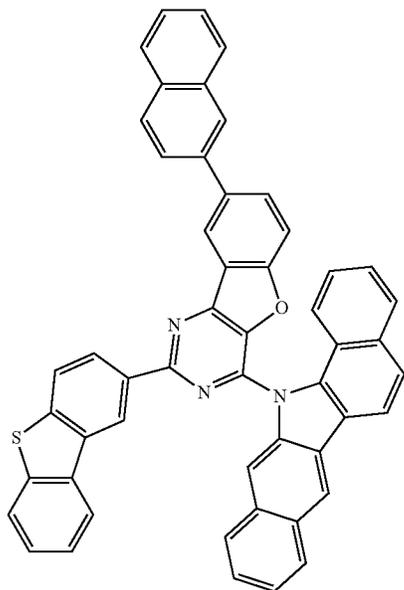
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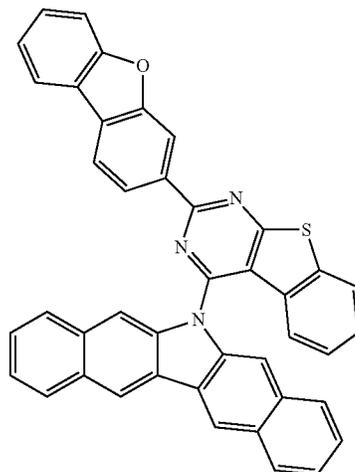
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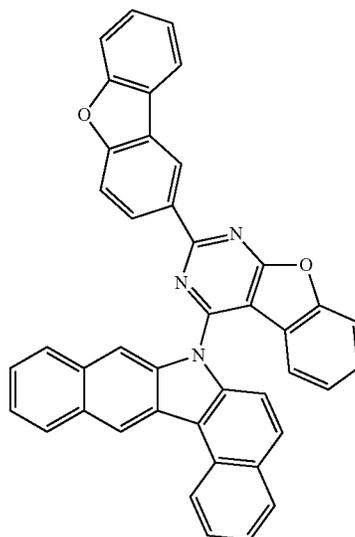
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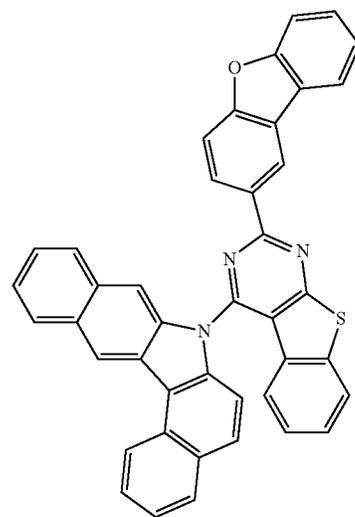
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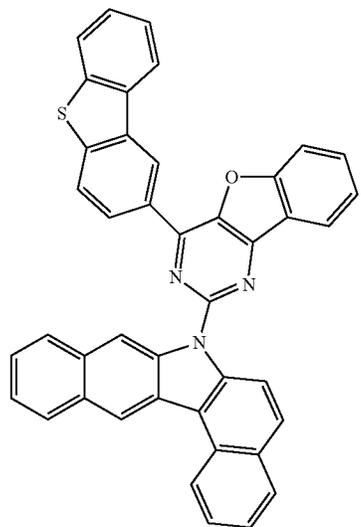
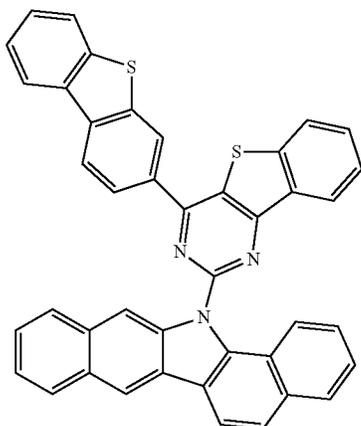
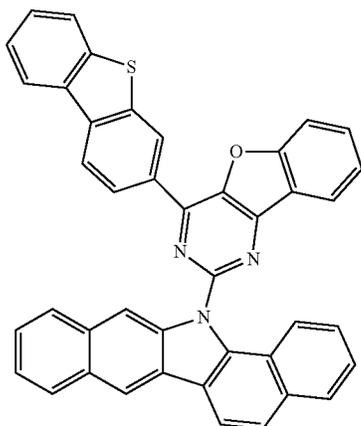
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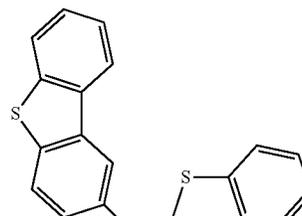
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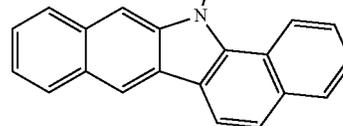
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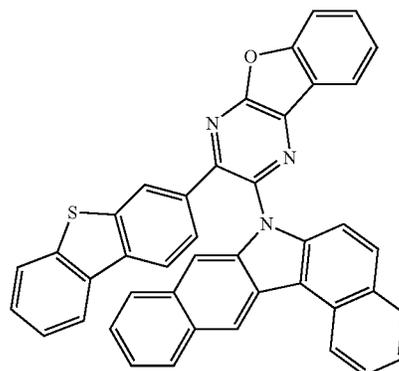


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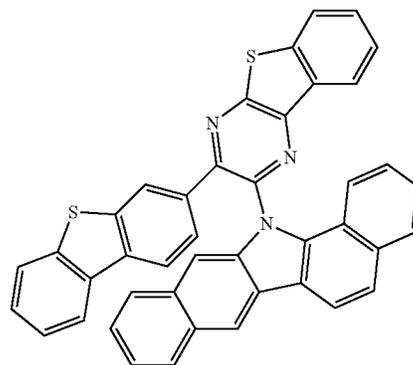


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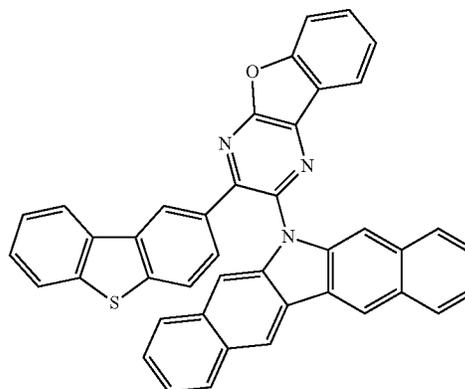
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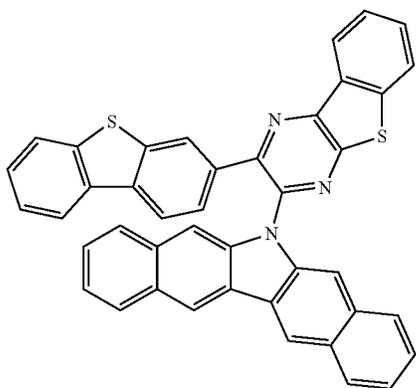
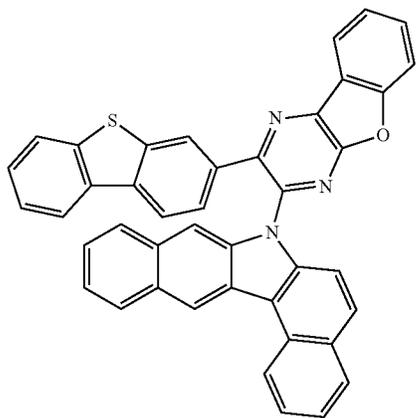
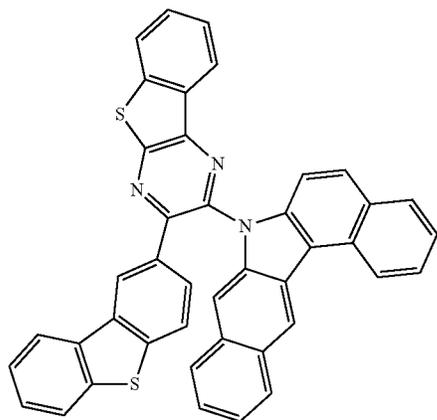


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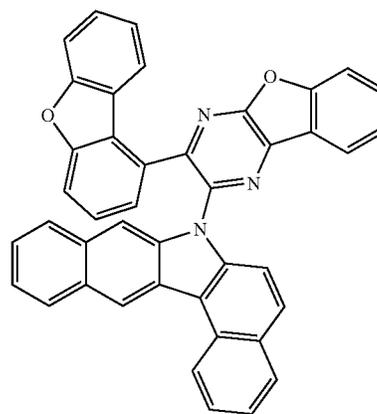
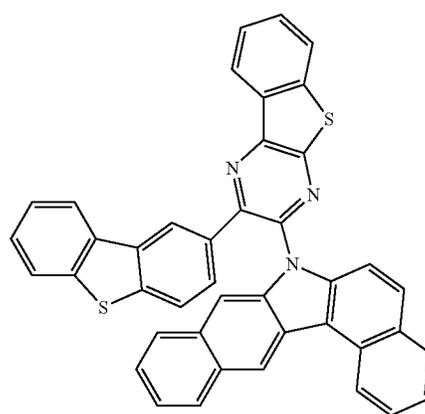
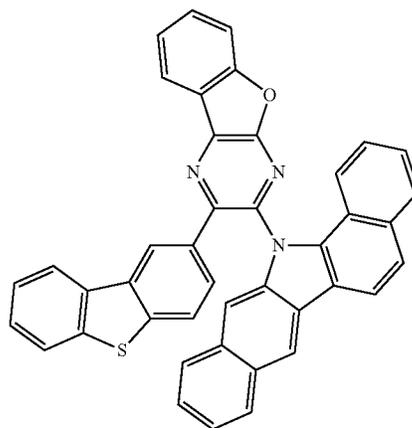
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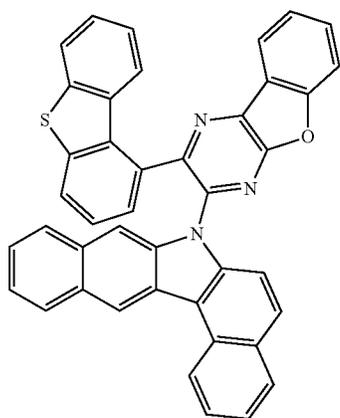
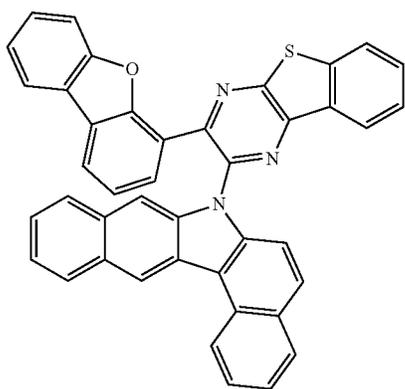
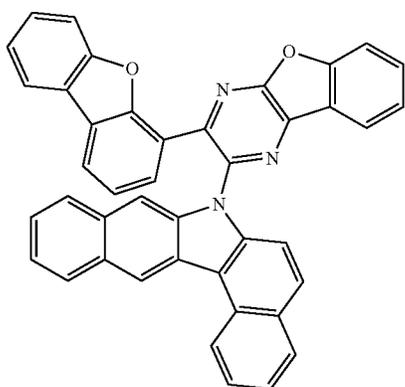
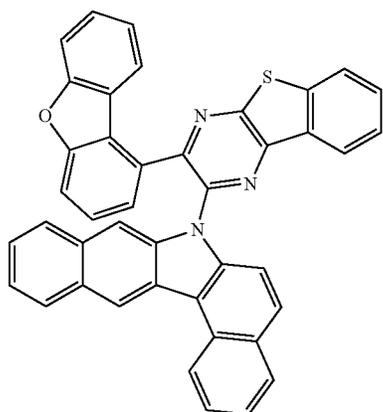
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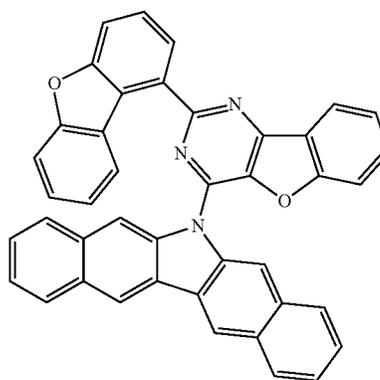
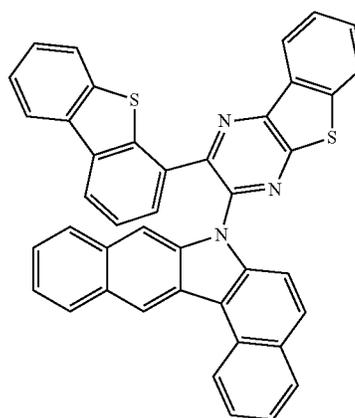
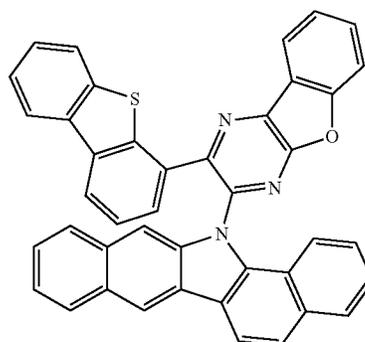
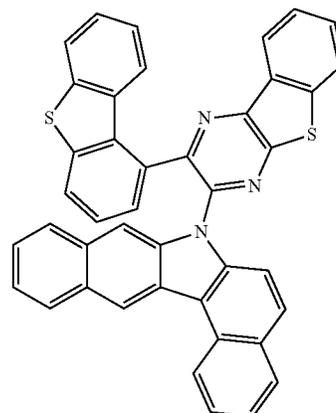
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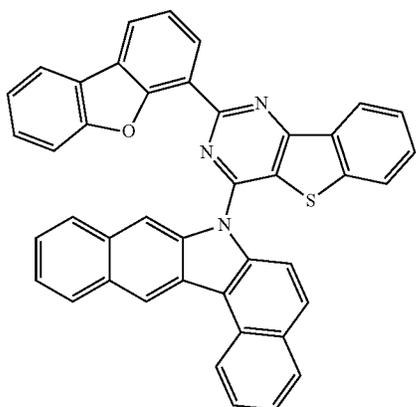
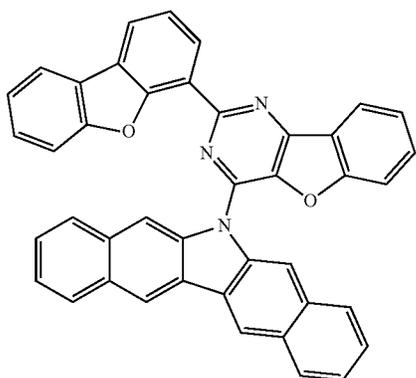
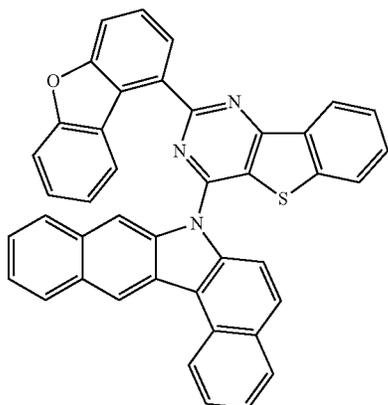
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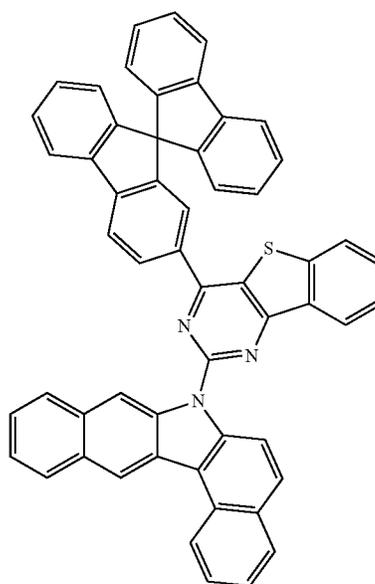
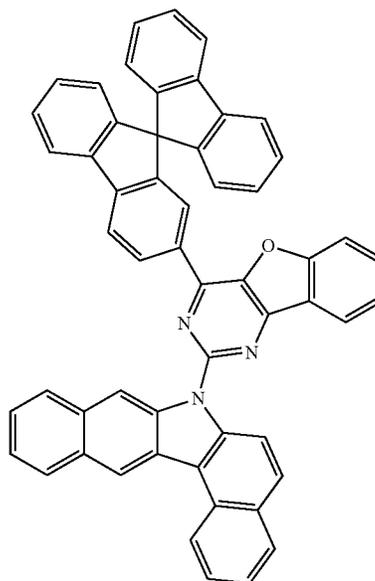
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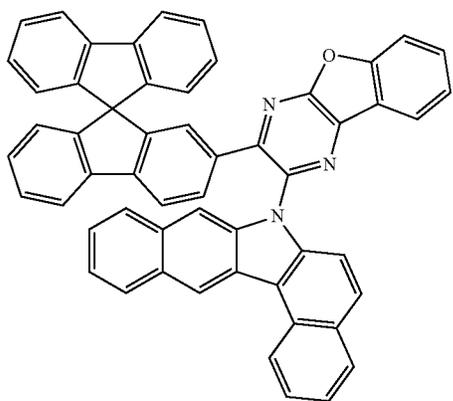
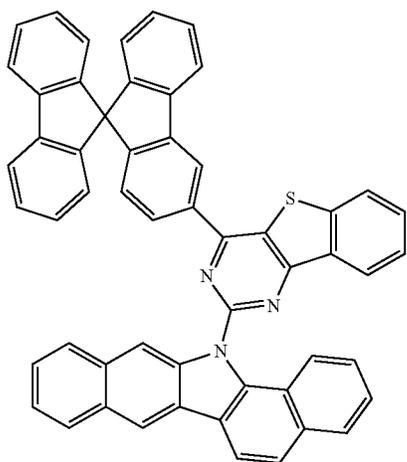
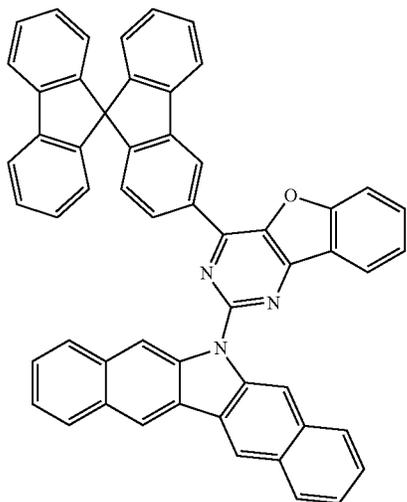
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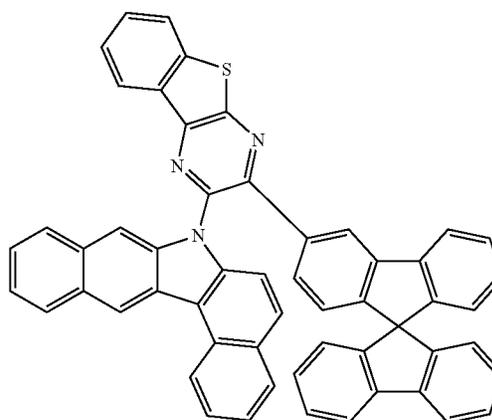
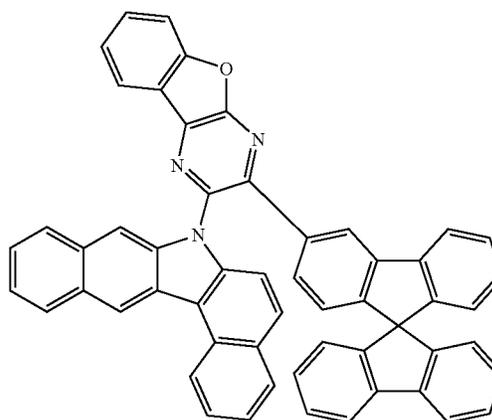
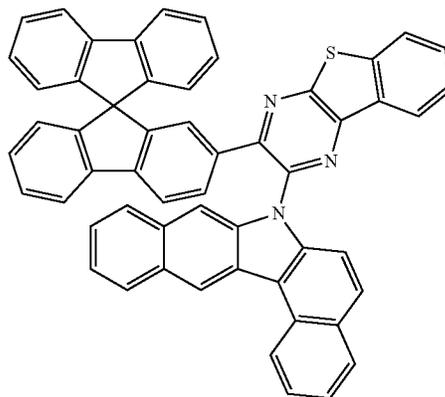
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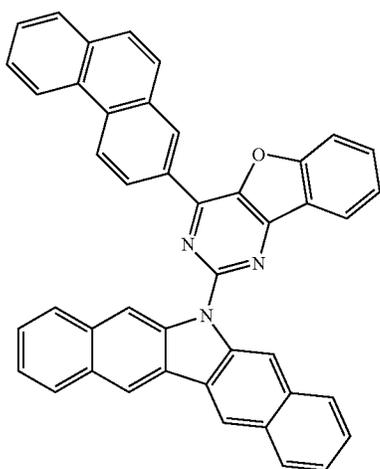
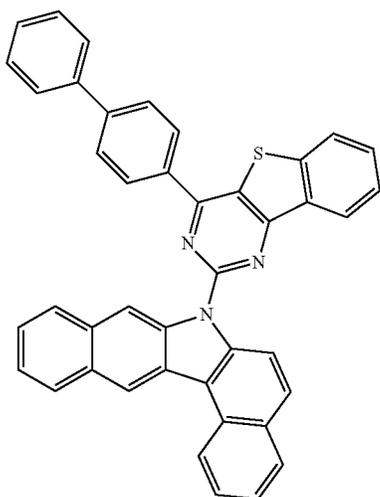
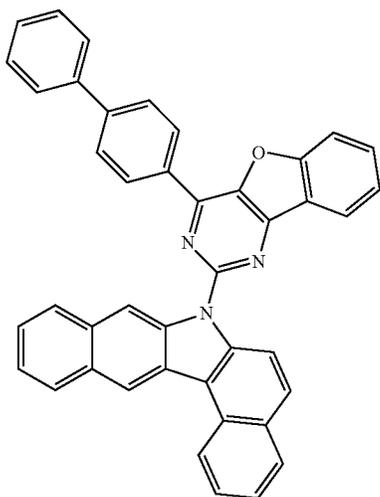
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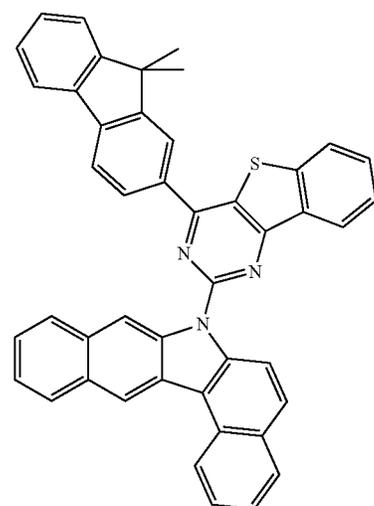
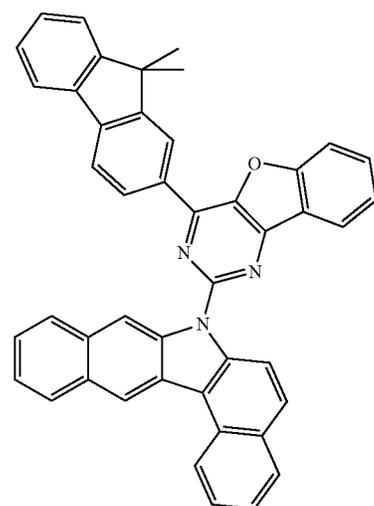
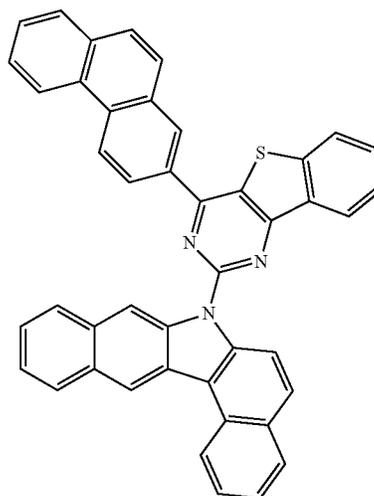
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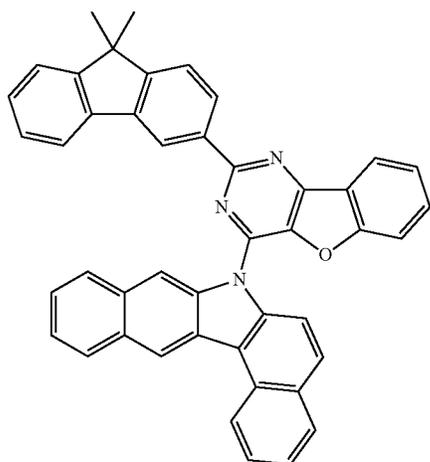
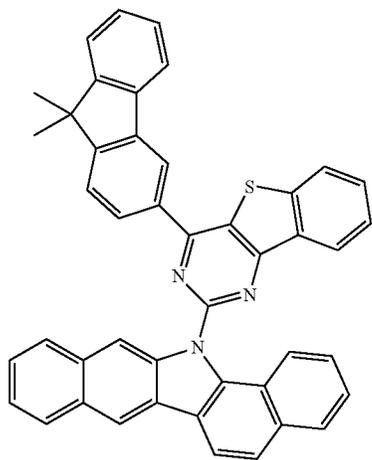
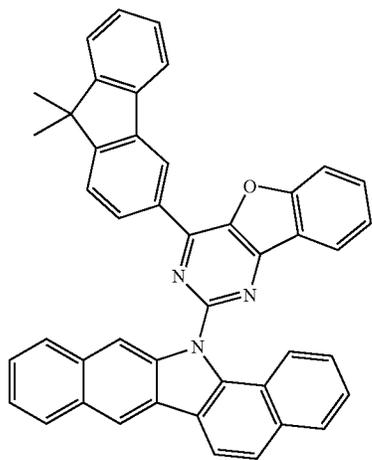
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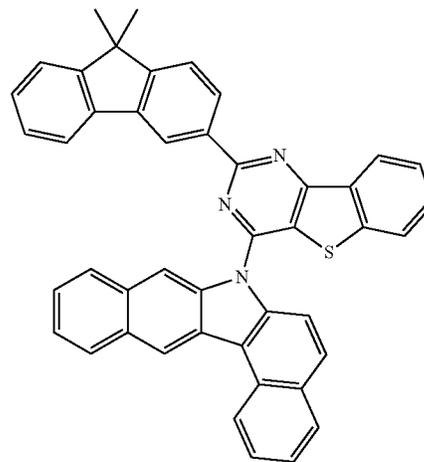
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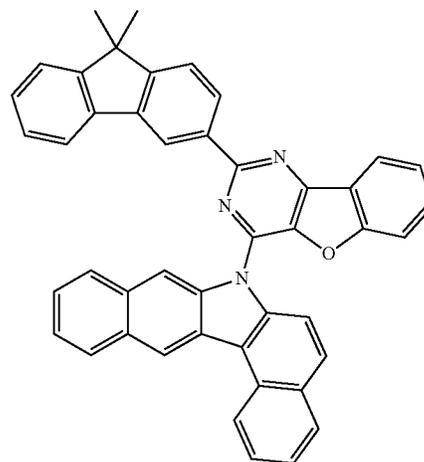
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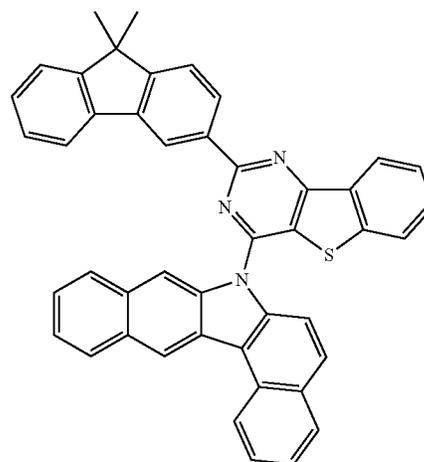
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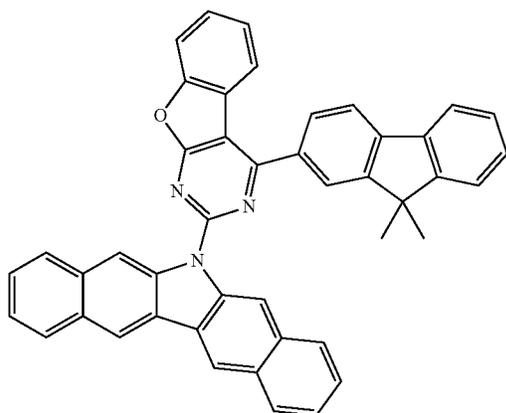
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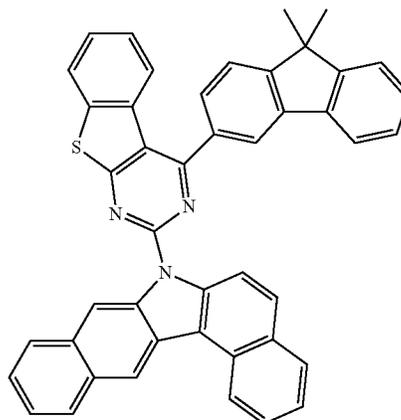
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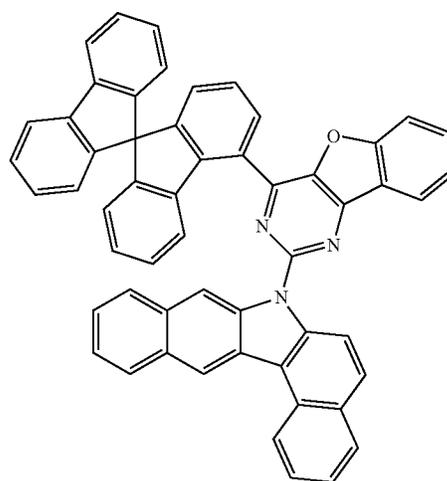
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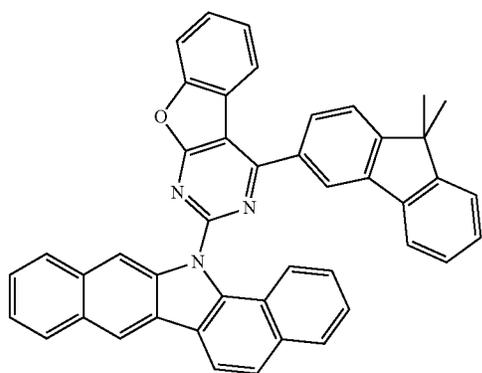
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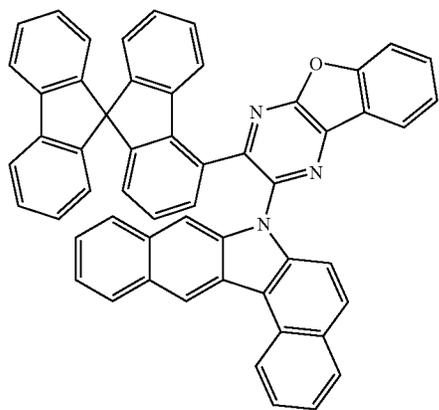
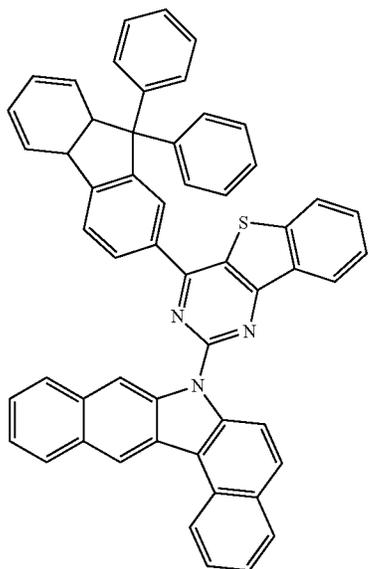
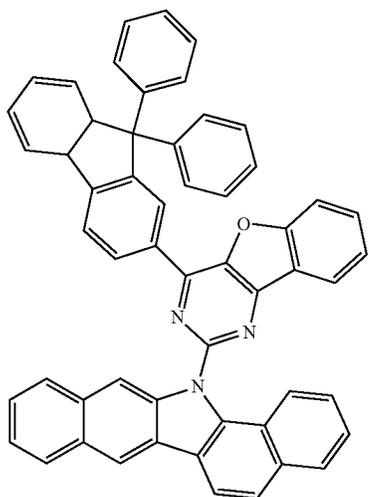
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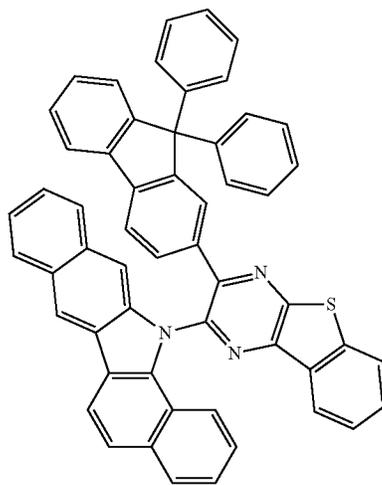
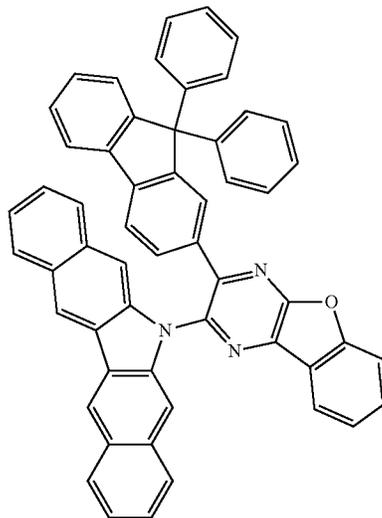
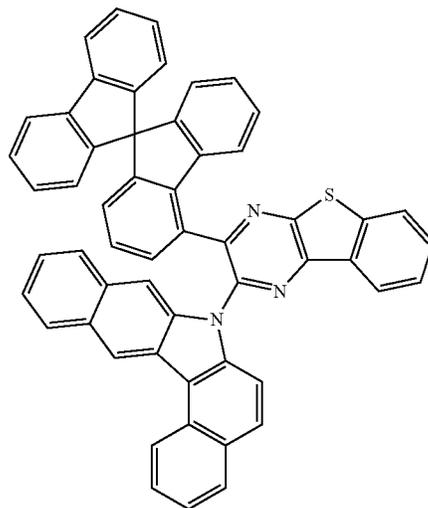
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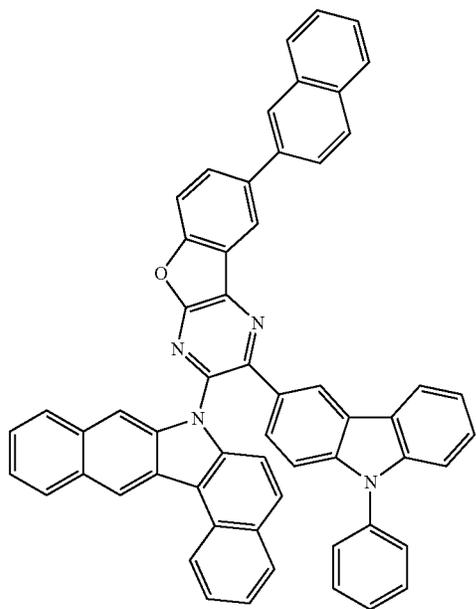
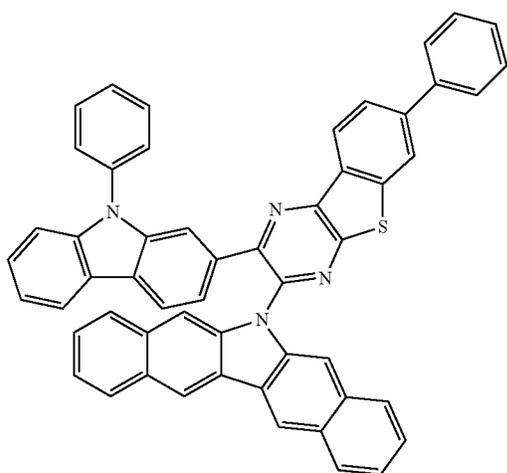
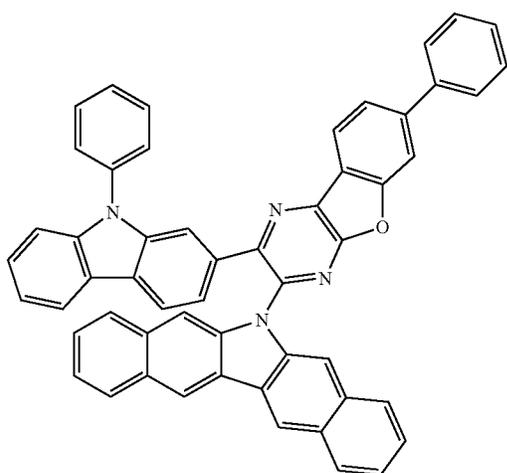
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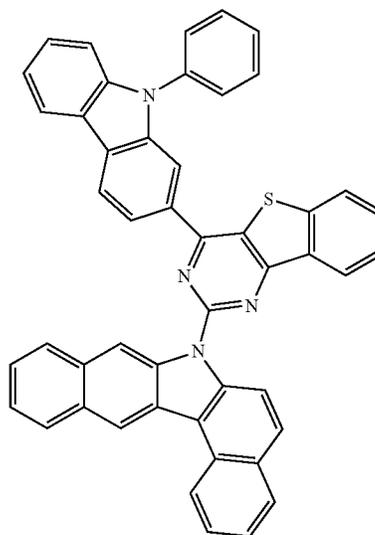
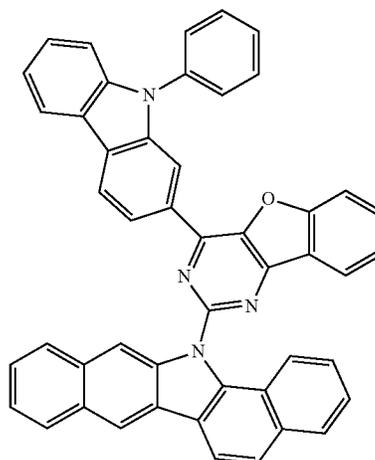
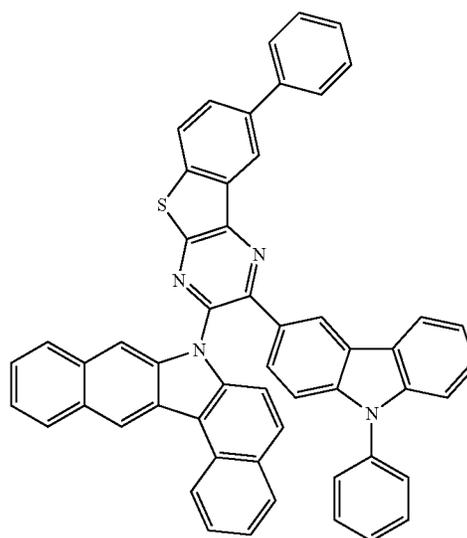
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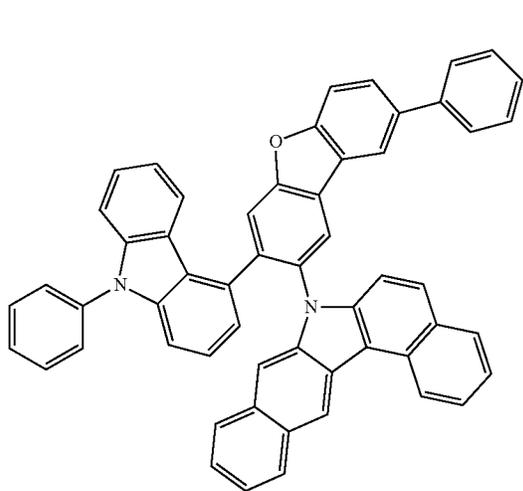
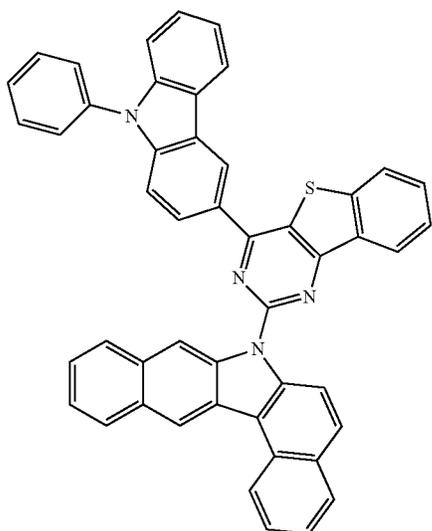
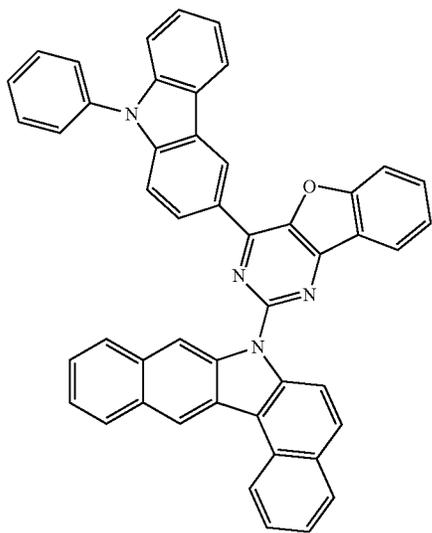
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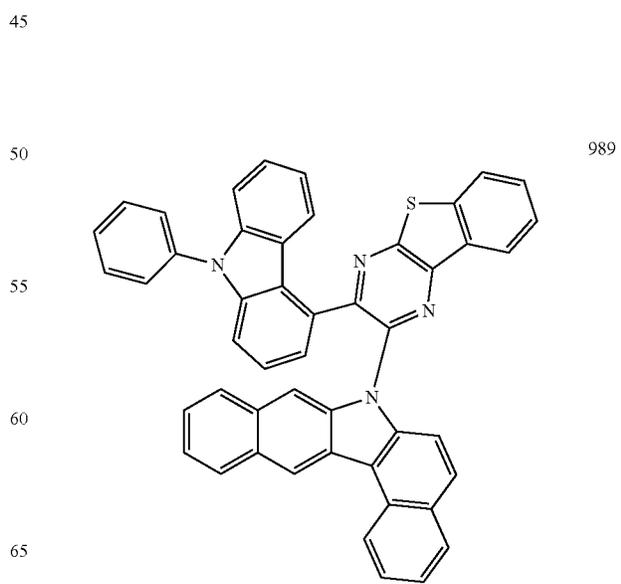
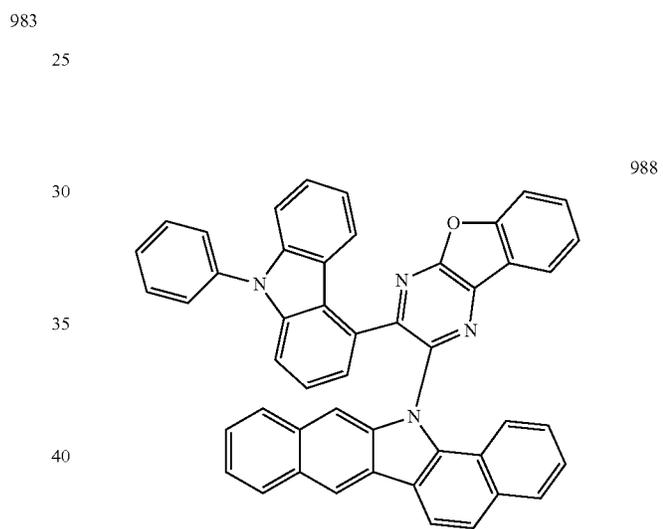
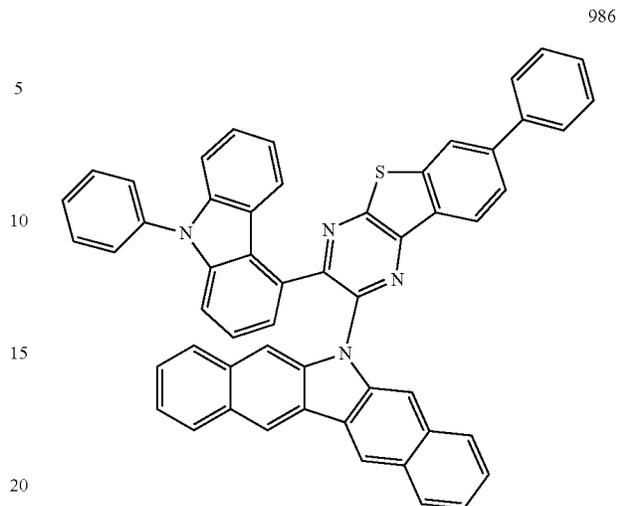
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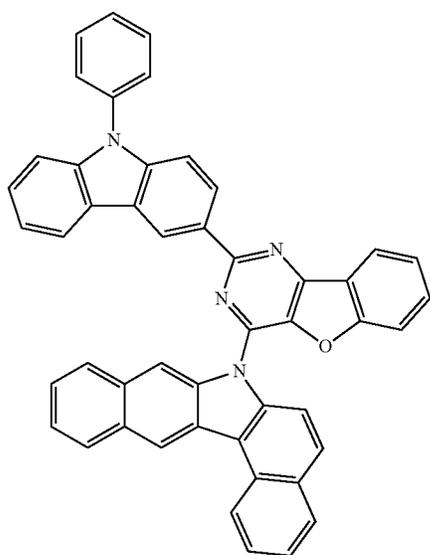
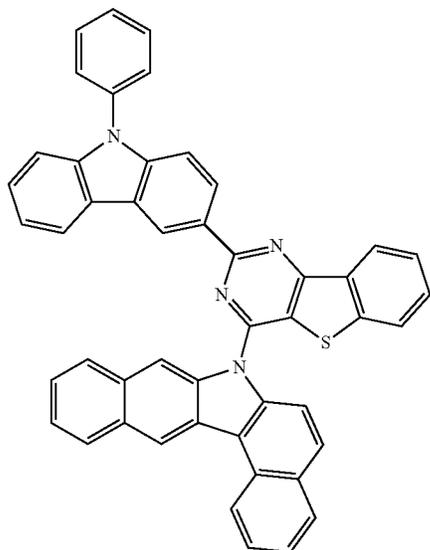
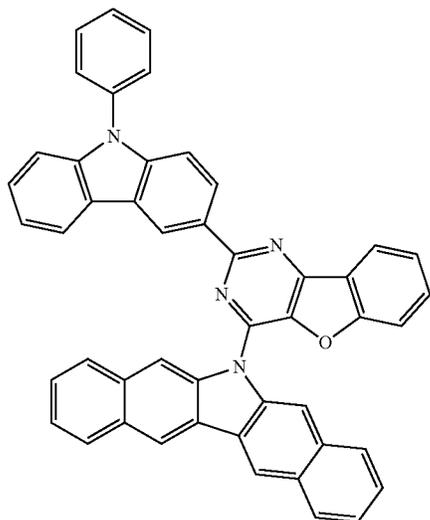


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**702**  
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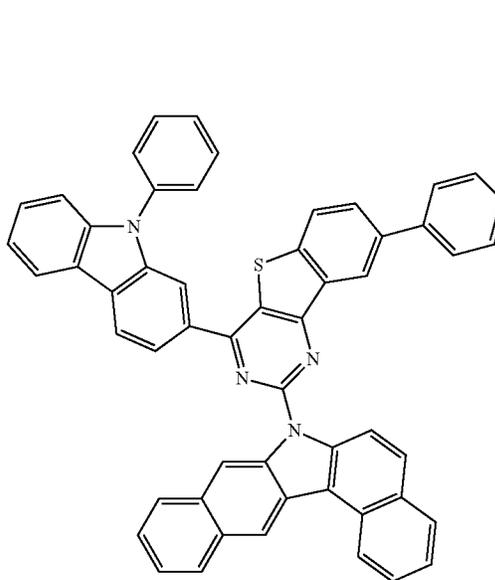
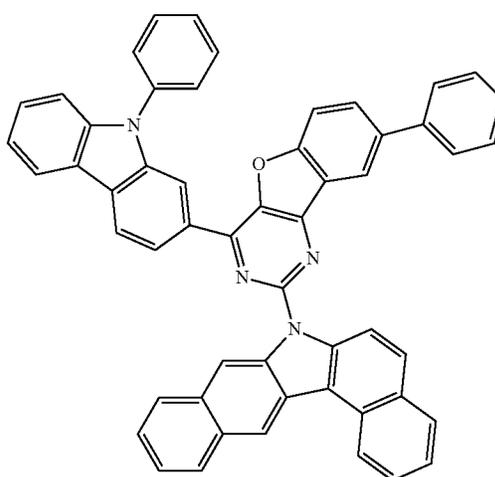
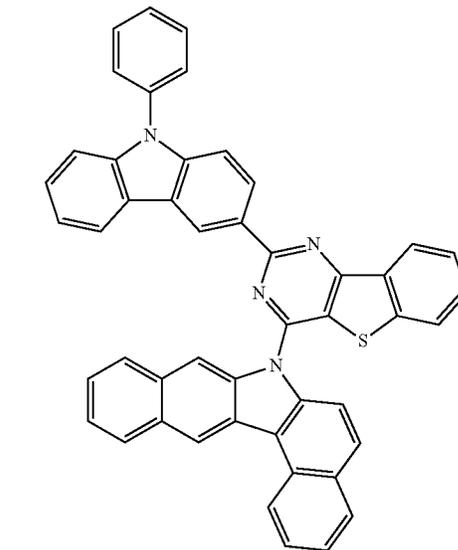
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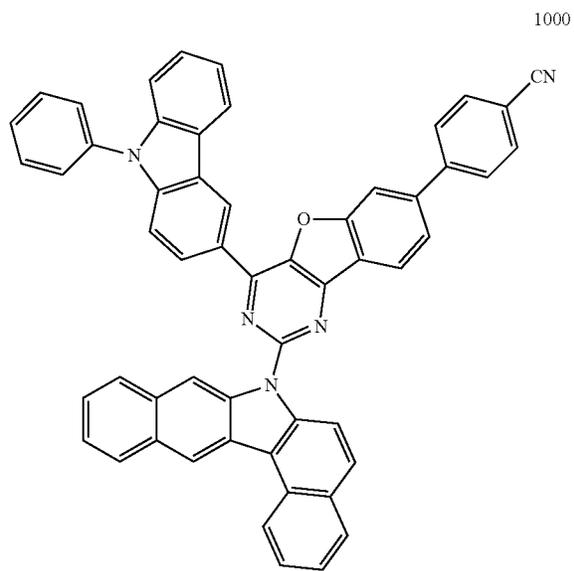
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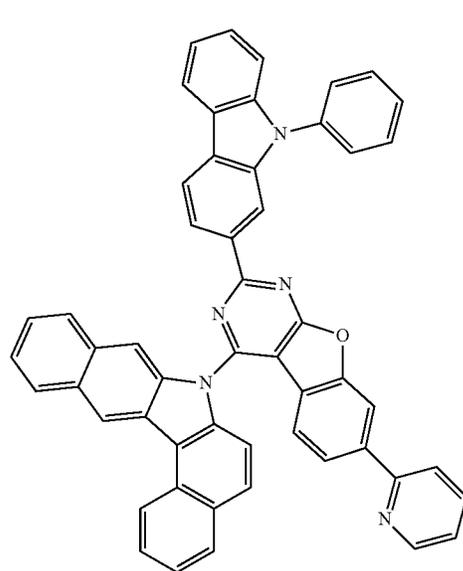
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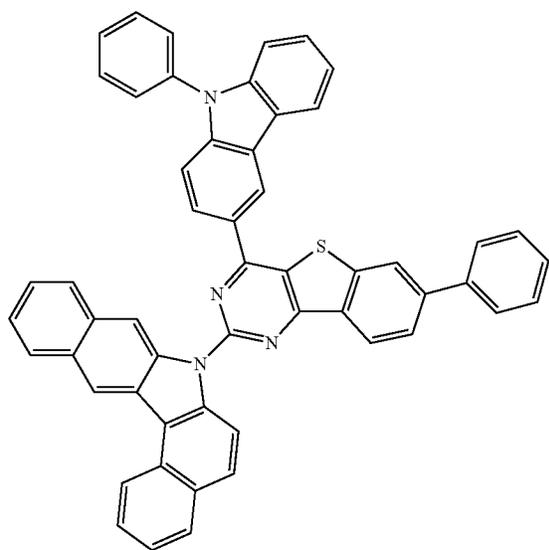
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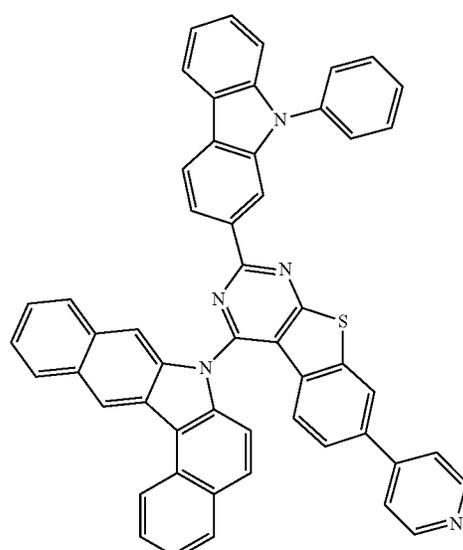
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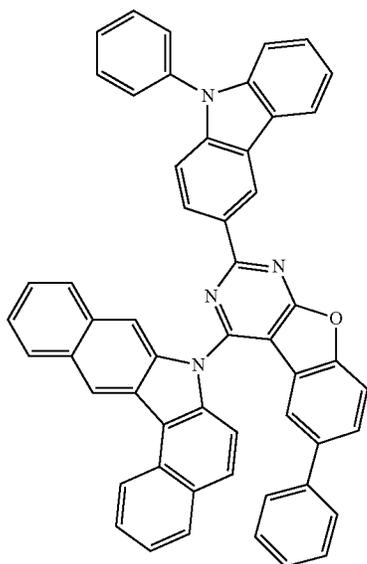
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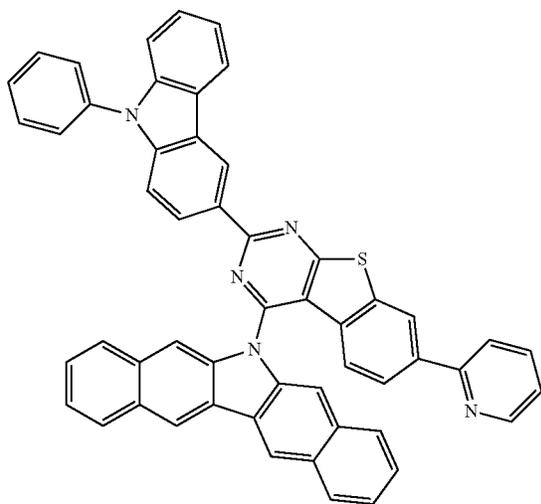
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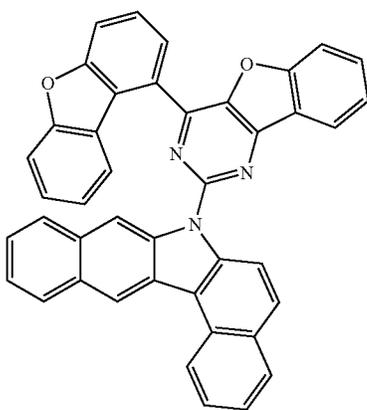
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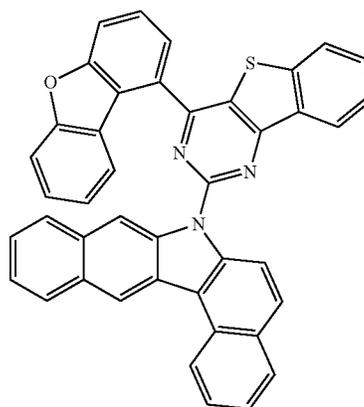


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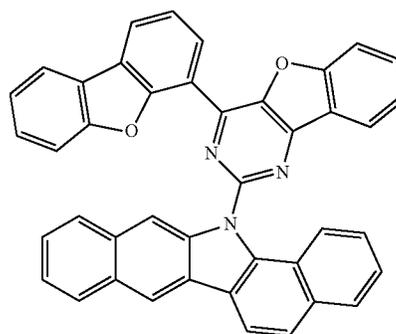
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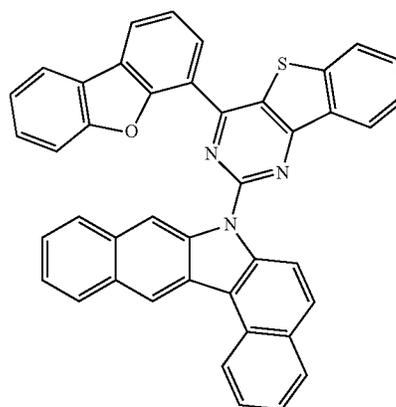


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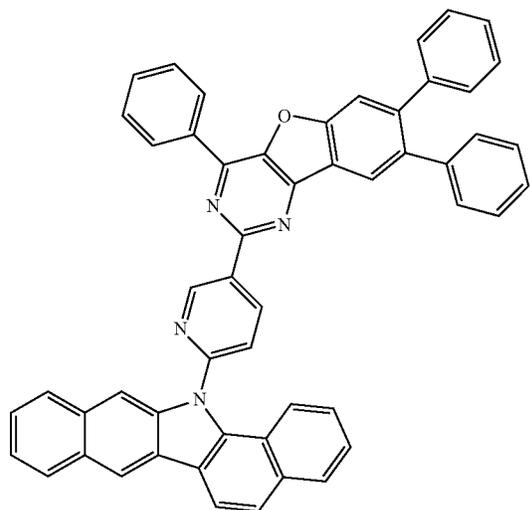


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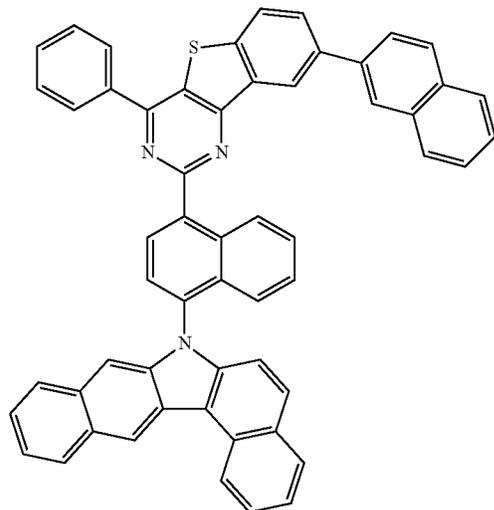
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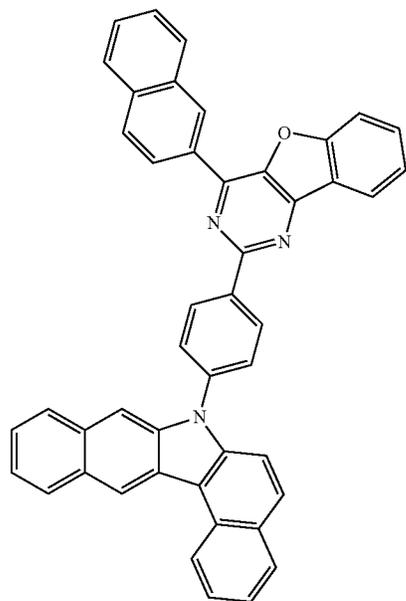
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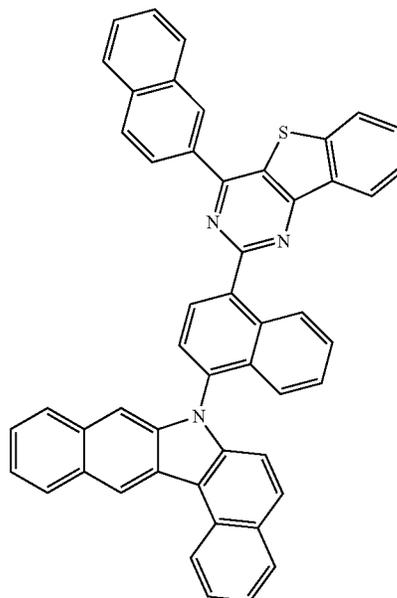
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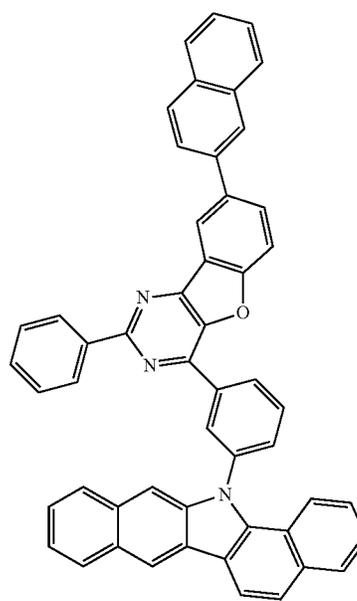
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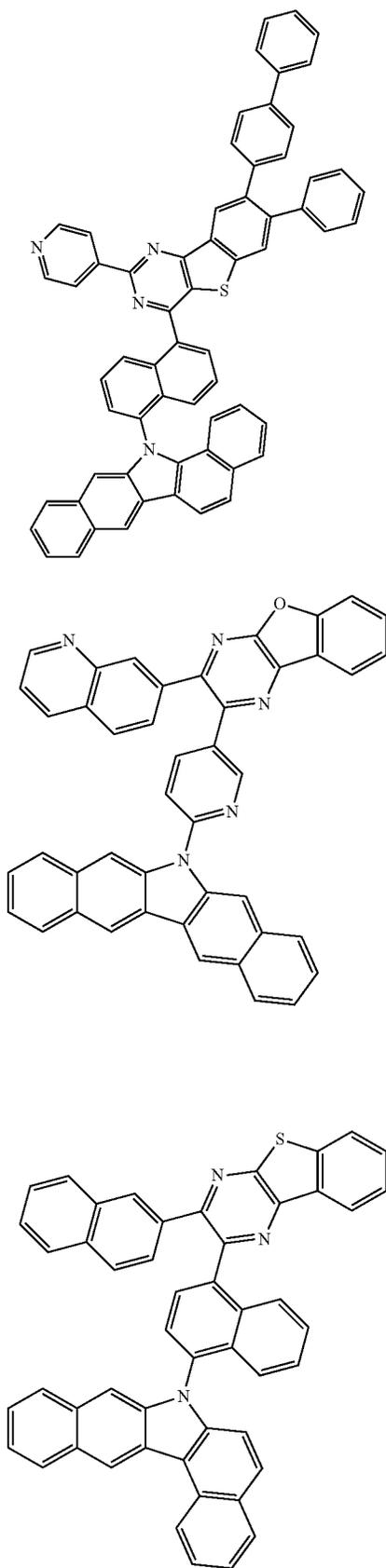
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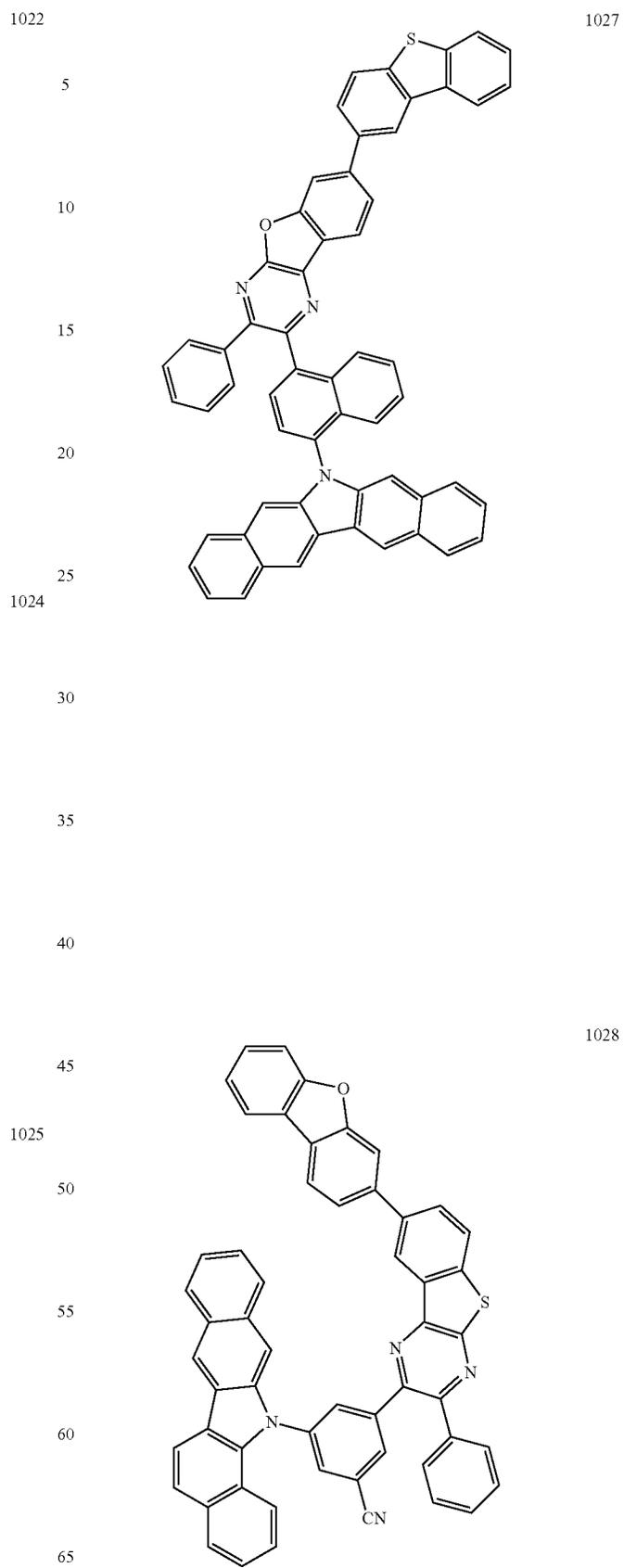
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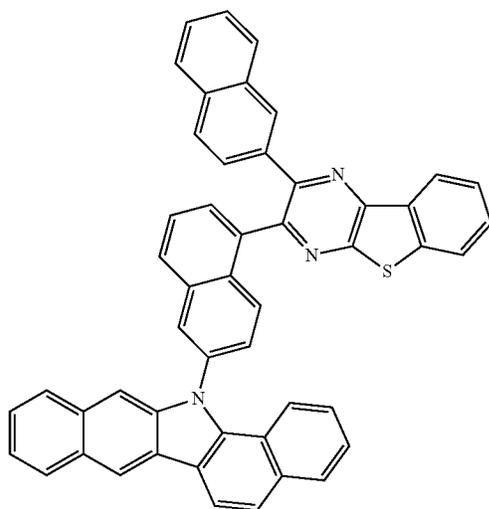
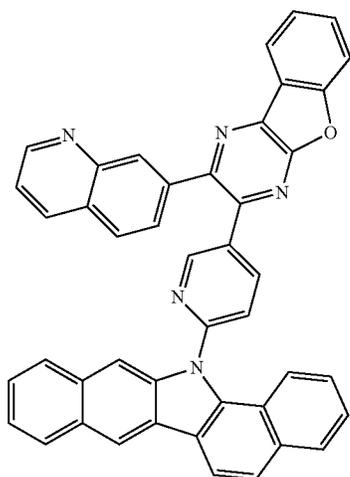


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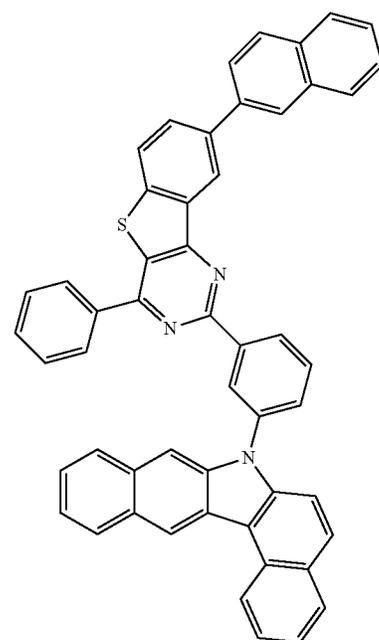
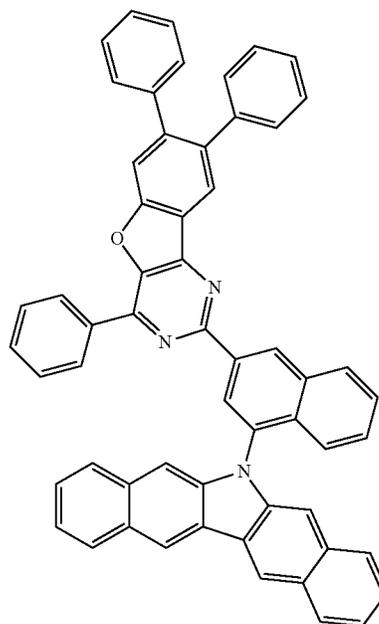
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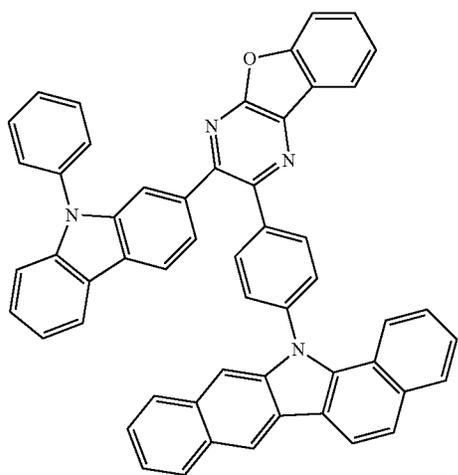
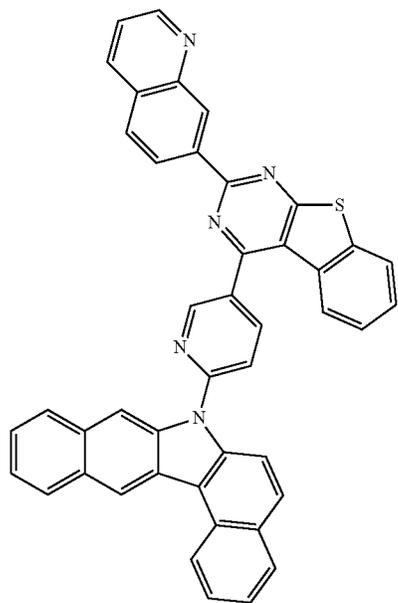
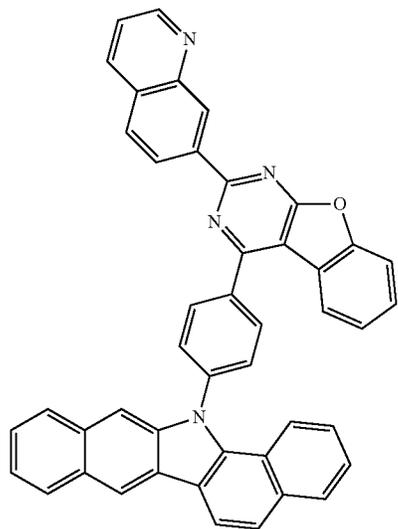


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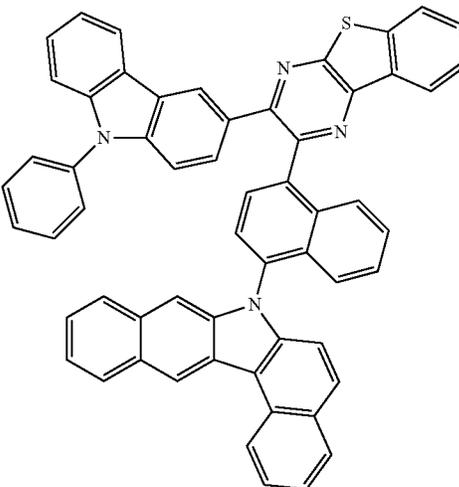
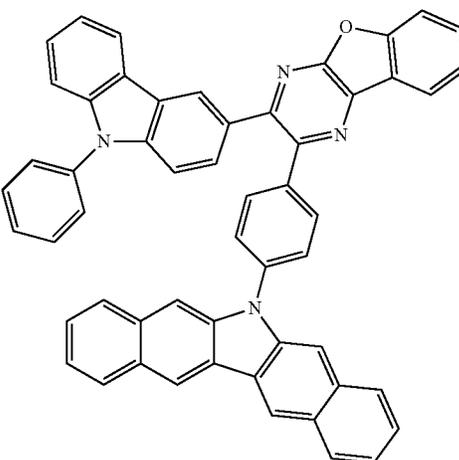
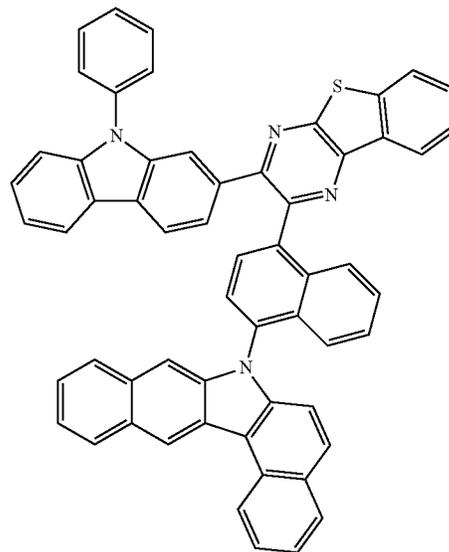
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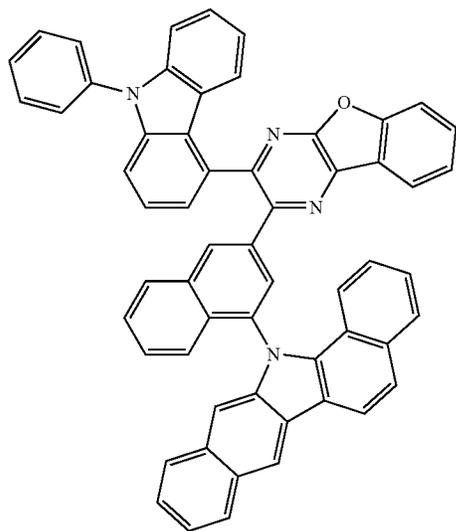
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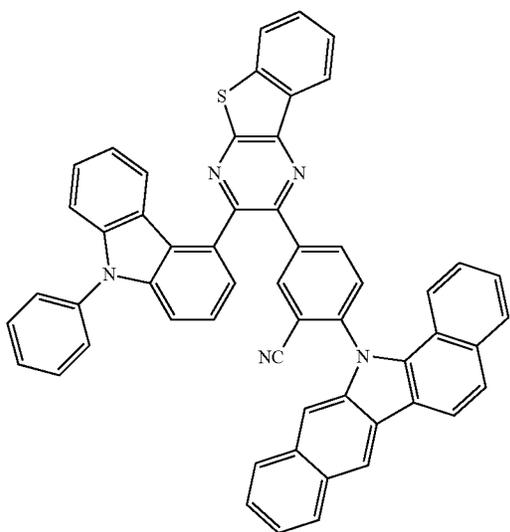


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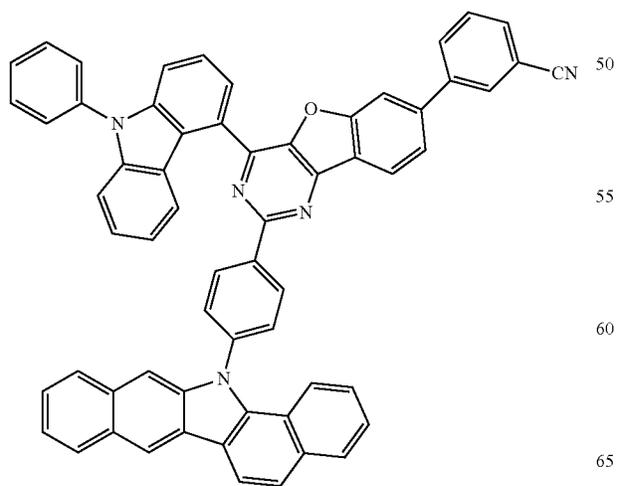
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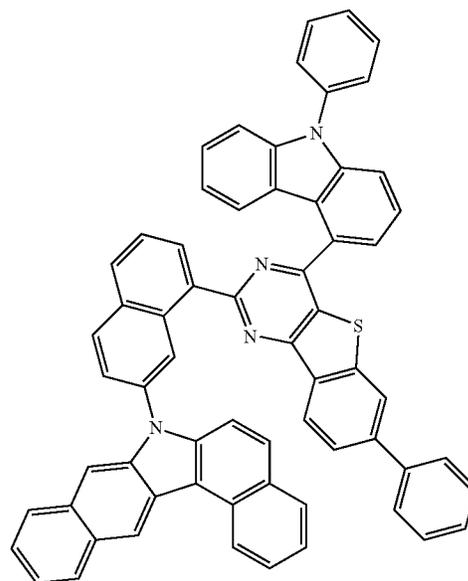
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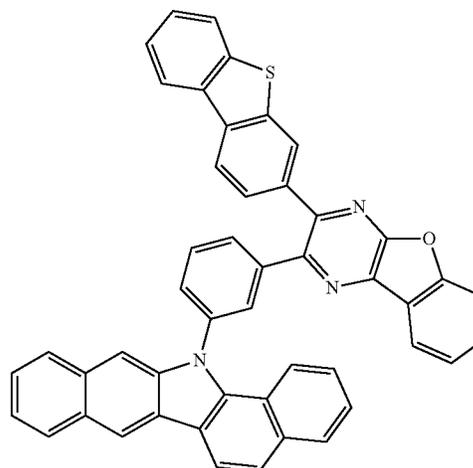
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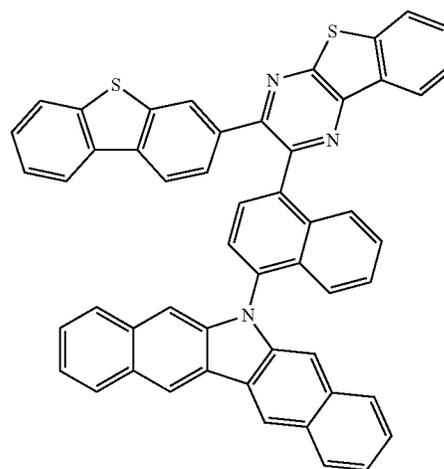
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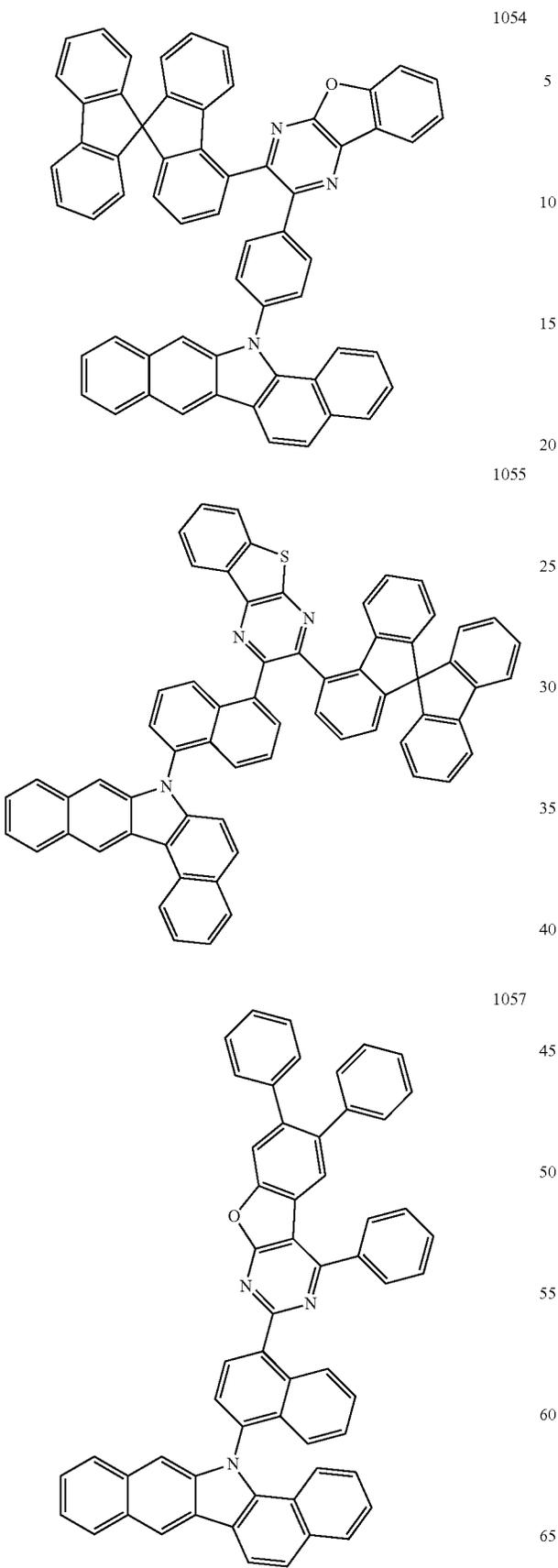
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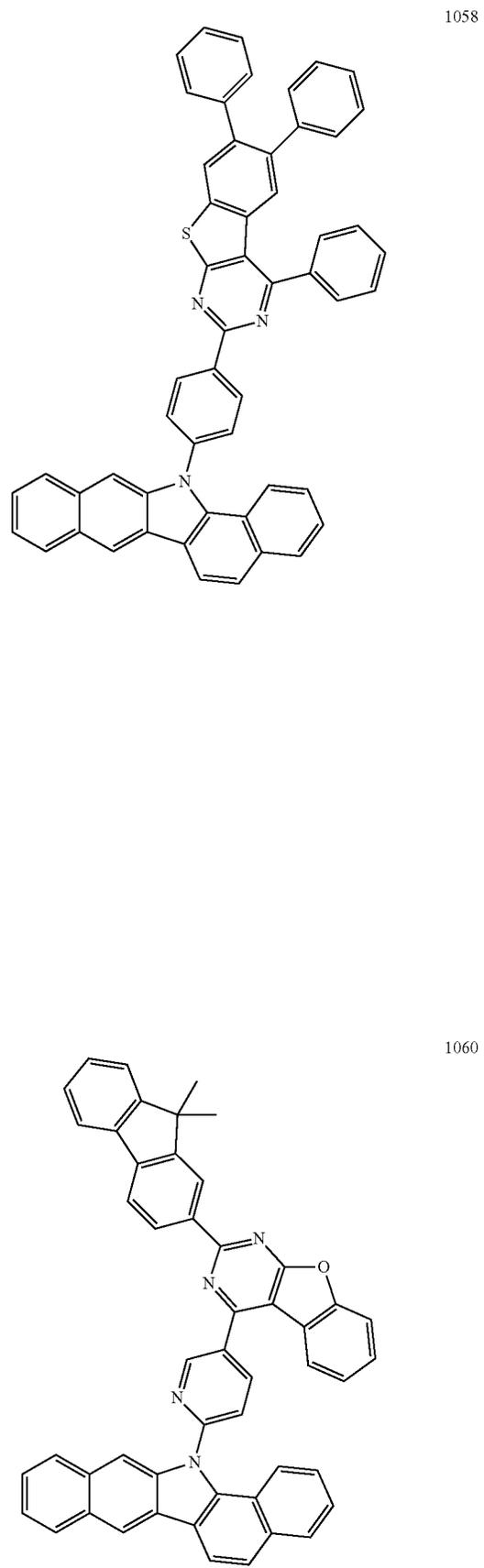
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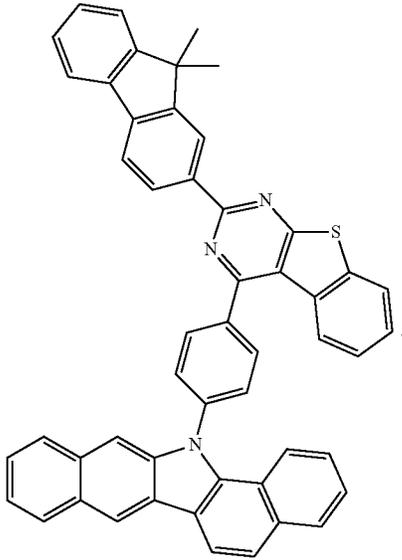


**718**  
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720

- 1061 6. An organic light emitting device comprising:  
 a first electrode,  
 a second electrode provided to face the first electrode; and  
 one or more organic material layers provided between the  
 first electrode and the second electrode,  
 5 wherein one or more layers of the one or more organic  
 material layers include the compound of claim 1.
7. The organic light emitting device of claim 6, wherein  
 the one or more organic material layers include a hole  
 injection layer or a hole transfer layer, and the hole injection  
 layer or the hole transfer layer includes the compound.  
 10
8. The organic light emitting device of claim 6, wherein  
 the one or more organic material layers include a light  
 emitting layer, and the light emitting layer includes the  
 compound.  
 15
9. The organic light emitting device of claim 6, wherein  
 the one or more organic material layers include an electron  
 transfer layer or an electron injection layer, and the electron  
 transfer layer or the electron injection layer includes the  
 compound.  
 20
10. The organic light emitting device of claim 6, further  
 comprising one, two or more layers selected from the group  
 consisting of a hole injection layer, a hole transfer layer, an  
 electron transfer layer, an electron injection layer, an elec-  
 tron blocking layer and a hole blocking layer.

\* \* \* \* \*